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ENGINEERING • CONSTRUCTION • OPERATIONS

PIPE LINE INDUSTRY

JANUARY
1960

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Construction Progress Report

WORLDWIDE OUTLOOK
1960 Can Be Record Year for Construction 18

TECHNICAL ADVANCES
Contractors Fight Costs With New Ideas 20

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Slick Epoxy Coated Pipe Can Be Pigged 28

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ENGINEERING GAINS
Watch These Big Developments in 1960 43

For a "Quick Look" at this issue, turn the page . . .

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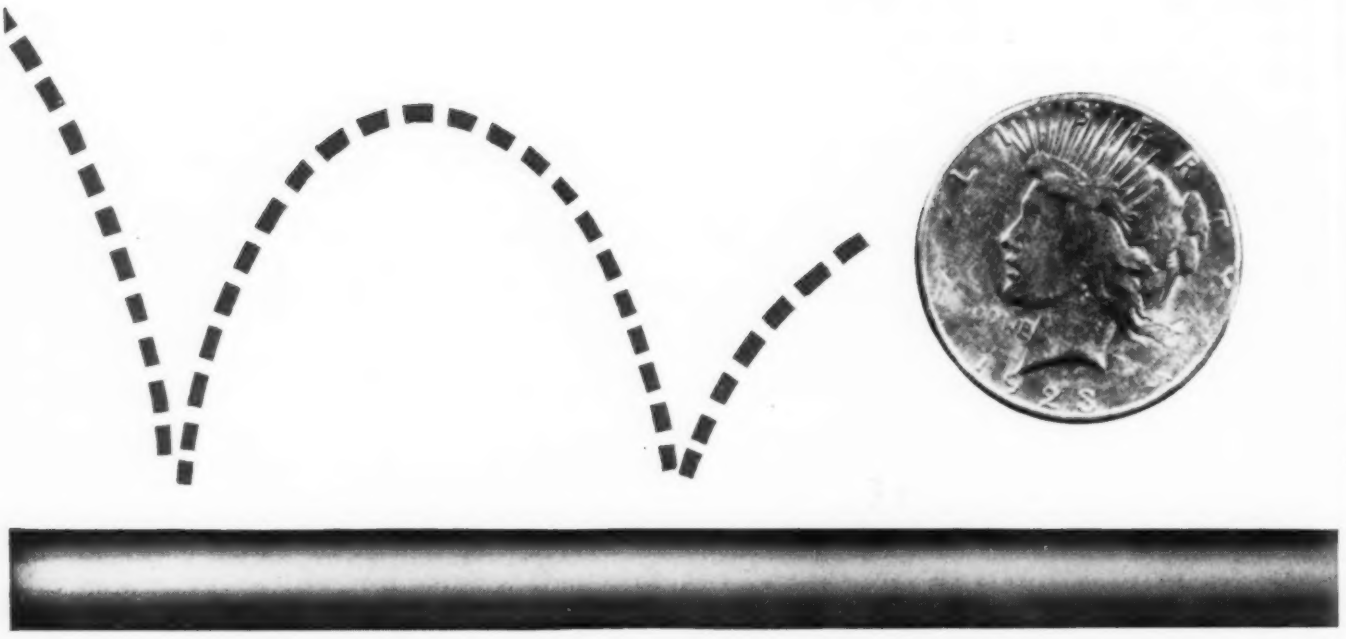

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PIPE LINE INDUSTRY

A GULF PUBLISHING COMPANY PUBLICATION

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CONTENTS and Quick Look

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

CONSTRUCTION PROGRESS REPORT

27,419 Miles of Pipe Line Planned for 1960

☐ Survey of 245 companies report a gain of 20 percent for Free World pipe line construction in 1960. Domestic natural gas pipe lines laid in 1959 totaled 13,125; continued growth is reflected in the forecast of 14,524 miles scheduled for 1960. Foreign construction in 1960 will be increased with 9,736 miles planned. Survey includes pipe diameters, station horsepower additions and prime movers to be installed.

By Melvin A. Judah and Donald G. De Pugh . . . Page 18

New Ideas Highlighted Construction in 1959

☐ With cost of labor continually rising, contractors have had to pick up efficiency to keep construction costs down. New ideas in construction methods and equipment keep them in business.

By Melvin A. Judah and Donald M. Taylor . . . . Page 20

Pipe Line Contractors to Meet in Los Angeles

☐ Pipe Line Contractors Association prepares for 12th annual convention at Los Angeles' Ambassador Hotel, January 31-February 3. . . . . . Page 27

Cleaning Internally Coated Lines

☐ This subject is very important to the gas industry today. Despite the hard, glassy surface of the coatings, they can be scratched by conventional wire brush pigging. Coating manufacturers have rated their materials after curing at 3H to 6H lead pencil hardness. In a series of tests aimed at finding the best means of cleaning the coated pipe, dry squeegees proved almost as severe on the coating as steel brush pigs because of the abrasive action of dust and sand. The best solution found in these tests of El Paso Natural Gas Company—use dishwater type detergent ahead of the pigs. Other good possibilities being studied by the industry are pigs equipped with fine wire brush or nylon bristles.

By Clinton McClure . . . . . Page 28

Designing Crossings of Railroads and Highways

☐ There are several methods: The API Code 1102, the American Railway Engineering Association, and the Design Criteria advanced by the American Society of Civil Engineers. Actually, the problem of design is relatively simple—it's a matter of soil mechanics and strength of materials—however, the attitude of governing bodies must be correlated to the engineering problems involved.

By Ernest A. Slade . . . . . Page 31

Nitrous Oxide and Infrared Detector Supply Answer to Leak Detection Problem

☐ For years pipeliners have had a vexing problem of finding water leaks in hydrostatic tests. The best method yet devised is to add a trace of nitrous oxide to the test water. When the latter escapes, the so-called "laughing gas" rises to the surface; it can be detected in concentrations as low as two parts per million and does not occur in nature.

By John E. Kaufman . . . . . Page 37

Safety Ideas That Paid Off

☐ Several pipe line contractors have found ways of improving safety conditions by modifying machinery and equipment. Innovations on shot-blast machines, cranes, coating applicators, tractors and double-jointing systems save lives and money for contractors.

By Donald G. De Pugh . . . . . Page 41

Recent Advances in Pipe Line Technology and Engineering

☐ Almost every phase of the industry was improved last year, and there were several dramatic advancements. Most important ones were: Internal coatings proved out; spheroids found many uses; new low cost gas-fired turbine is being made from jet aircraft engine; filmless X-rays of pipe; new high pressure horsepower gas-fired turbine installed for unattended operation and jacket water is now being used to drive cooling fans.

By Donald M. Taylor . . . . . Page 43

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GUEST EDITORIAL

What's Ahead for Pipe Line Construction?

World Surpluses Affect Outlook

By John H. Williams, President
Pipe Line Contractors Association

As is common knowledge, the full impact of growing petroleum surpluses was postponed by the Korean War and the various Middle East crises, but it began to be felt in a big way in 1958 and continued to be felt through 1959.

J. H. Williams

Among other things, the resulting budget cuts began affecting planned and projected pipe line construction projects. Even the domestic gas industry, less affected by the world oil market, did not provide the amount of building which was indicated when the Memphis Decision was favorably resolved last year.

More recently we have been experiencing another retarding factor which is limiting projects to those with priority higher than normal—the tight money market. Increased rates of return will undoubtedly have to be authorized to the regulated gas companies to provide for the greater cost money.

Even so, the outlook is bright for a high rate of pipe line construction. There is much evidence that world demand for energy is rising rapidly and that continuous building will be required to create the network of pipe lines required to fulfill the need. Pipe lines already are the largest ton-mile carrier of any form of inland transportation in the United States and will see even greater growth.

Modern American pipe line building has extended to foreign lands; it will be more of an international business in the future. Pipe lines have only begun in the areas which are just now beginning to use this natural resource.

The keen competition that exists among the members of the Pipe Line Contractors Association, and among their suppliers, has resulted in continuous improvement in the methods of building pipe lines so that not only have the costs of construction been kept from rising, but in the face of labor costs about two-thirds higher than ten years ago, construction costs are slightly less than ten years ago. We are laying better pipe lines than ever before so the owners can expect a better job.

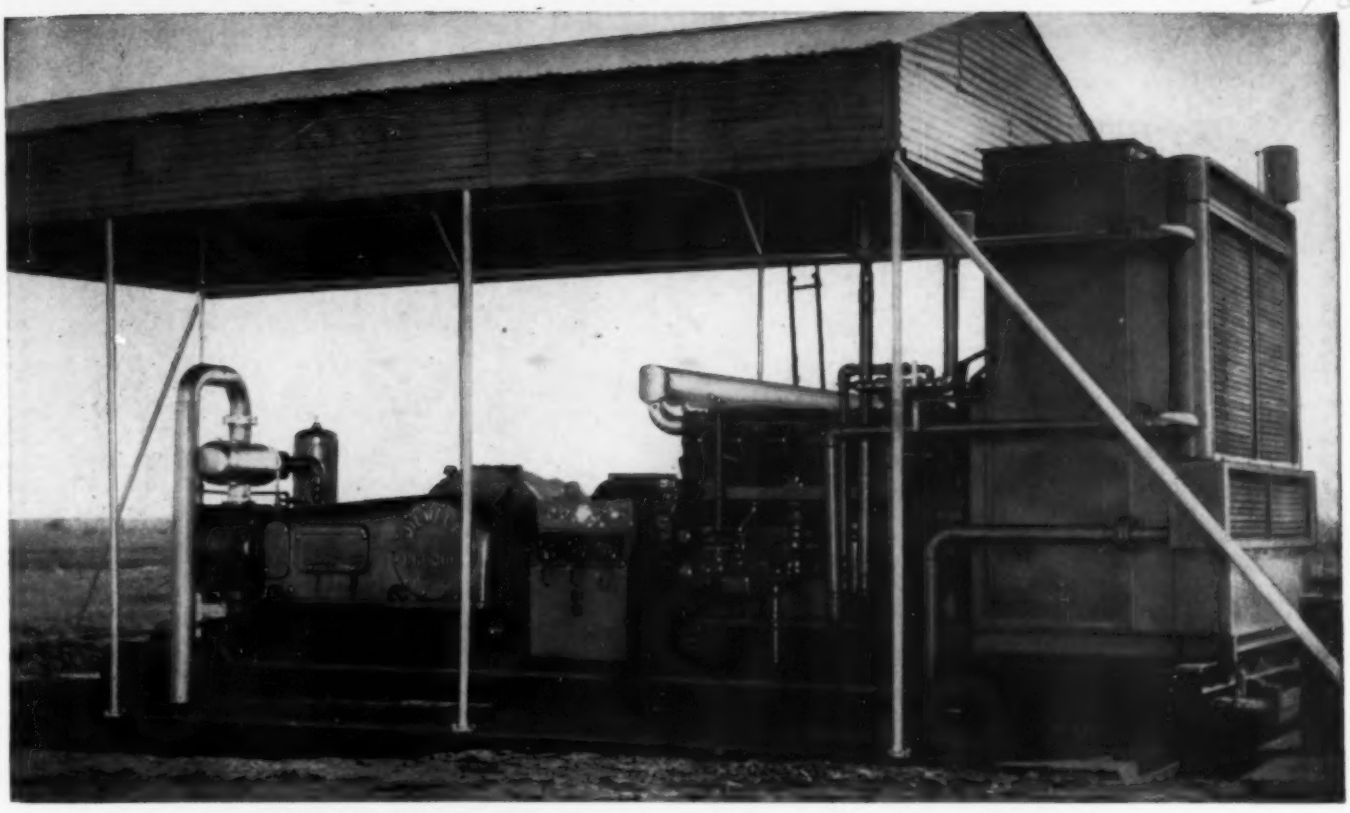
Economic feasibility of pipe lines is increasing as engineering improves the efficiency of capacity, operating costs, and investment. More automatic operation, better communications, telemetering and other innovations have helped.

Higher yield strength X-56 pipe has now been introduced and before long yields may be even higher. This will have a marked effect on pipe line investment per unit of capacity—and this could open new areas of feasible pipe line applications similar to that produced by the introduction of expanded X-52 pipe for the big postwar gas lines. Gas transmission companies, faced with going farther and paying more for gas today, are calling on special ingenuity in engineering of future lines to help fill the economic gap.

World energy surpluses that today appear as burdens are but deferred investments. Energy demands are increasing on a world-wide basis; the scope of construction functions to service this demand is increasing proportionately.

Pipe line construction activities are no longer limited fundamentally to the United States, but the market has expanded in direct proportion to oil and gas discoveries and needs. The unit cost of pipe line transportation is competitive with any other media, if not lower than most media, and it offers that additional advantage of continuity of supply.

Plans are being made for bigger and better pipe lines; the pipe line contracting industry is just now approaching the era of demand for construction on an international scale equal to or greater than the demand for domestic construction. Domestic construction is now at an all time high; coupled with this growing international program, it promises a long future for a growing industry.



This "Oilwell" DGE 300 Compressor is a two-stage unit in a gas-lift operation, and can handle up to 3,160,000 cu. ft. of gas per day at 400 psig intake and 1,500 psig discharge pressures.

Pumping gas?

See the advantages you get with

"Oilwell" DGE Compressors

In this popular DGE line, dual compressor units are mounted side by side and powered by a single prime mover through direct-connected, right-angle spiral gearing. Updraft radiator, with separate compartments for cooling engine, compressor cylinders and interstage gas . . . together with control panel and all inter-unit piping . . . are all compactly mounted on a heavy-duty, structural steel skid base. Consequently, these units are completely portable and ready for service as soon as they are installed.

Compressors are slow-speed, horizontal type—top-suction and bottom-discharge. Slow speed operation results in minimum wear on moving parts and corresponding low maintenance costs. All vital parts are enclosed.

DGE Units are available in 125 hp up to 300 hp sizes . . . and can be furnished for single or multistage compression. They have proven their superiority for many well-known companies in . . . gas-gathering operations . . . gas transmission to main distribution systems . . . pressure maintenance programs . . . recycling of natural gas . . . oil production using gas-lift . . . underground gas storage . . . and gasoline plant, refinery and petrochemical plant operations.

That's why we urge you to contact your nearest "Oilwell" store, or write COMPRESSOR DEPARTMENT, Oil Well Supply, Dallas 21, Texas . . . and get specific information on a DGE unit for every gas-pumping problem within this size range.

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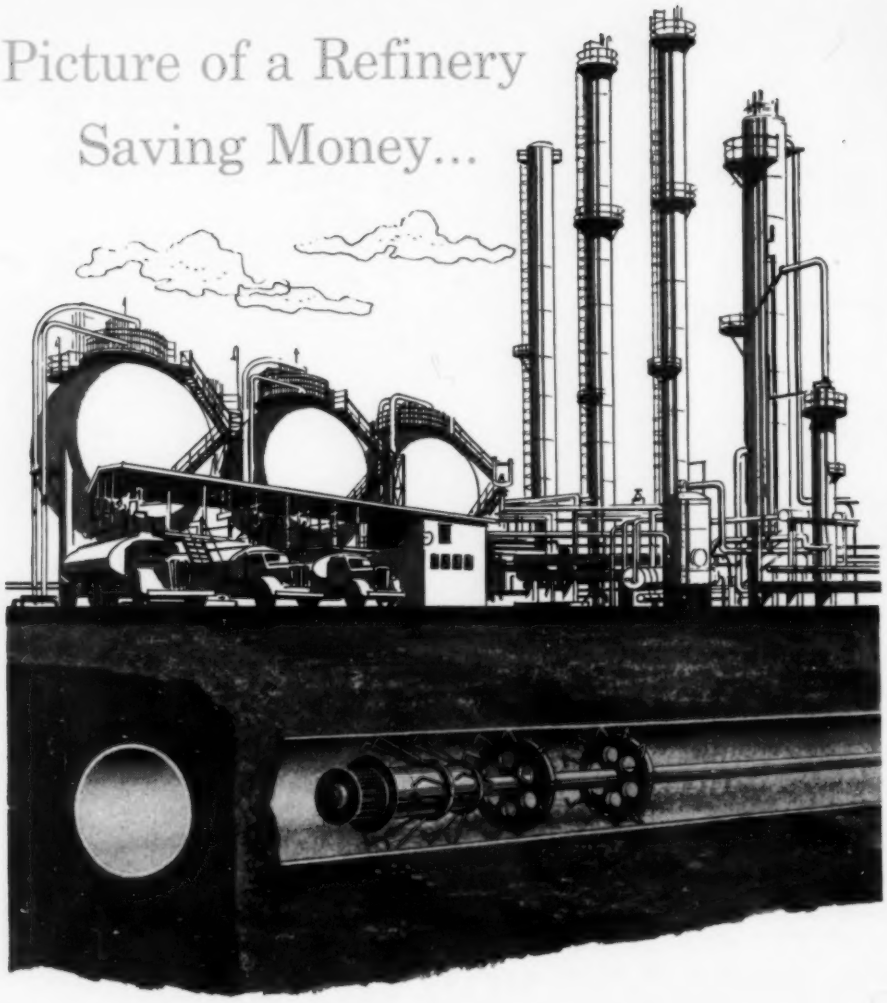
Picture of a Refinery
Saving Money...



Spunline Relines Pipe Lines in-place without removing the pipe

Another refinery, it could be in Texas, California or Montana, will soon be enjoying the savings of another rehabilitated pipe line. The flow will increase, the pumping cost will drop and the pipe line will be good as new for at least another quarter of a century.

And traffic will move without interruption or inconvenience to the public.

Spunline® is applicable to pipe lines down to 4" and may be used in cast iron, steel, concrete and wrought iron pipe lines.

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PETROLEUM REFINER and The REFINERY CATALOG for the oil, gas and petrochemical processing industry.

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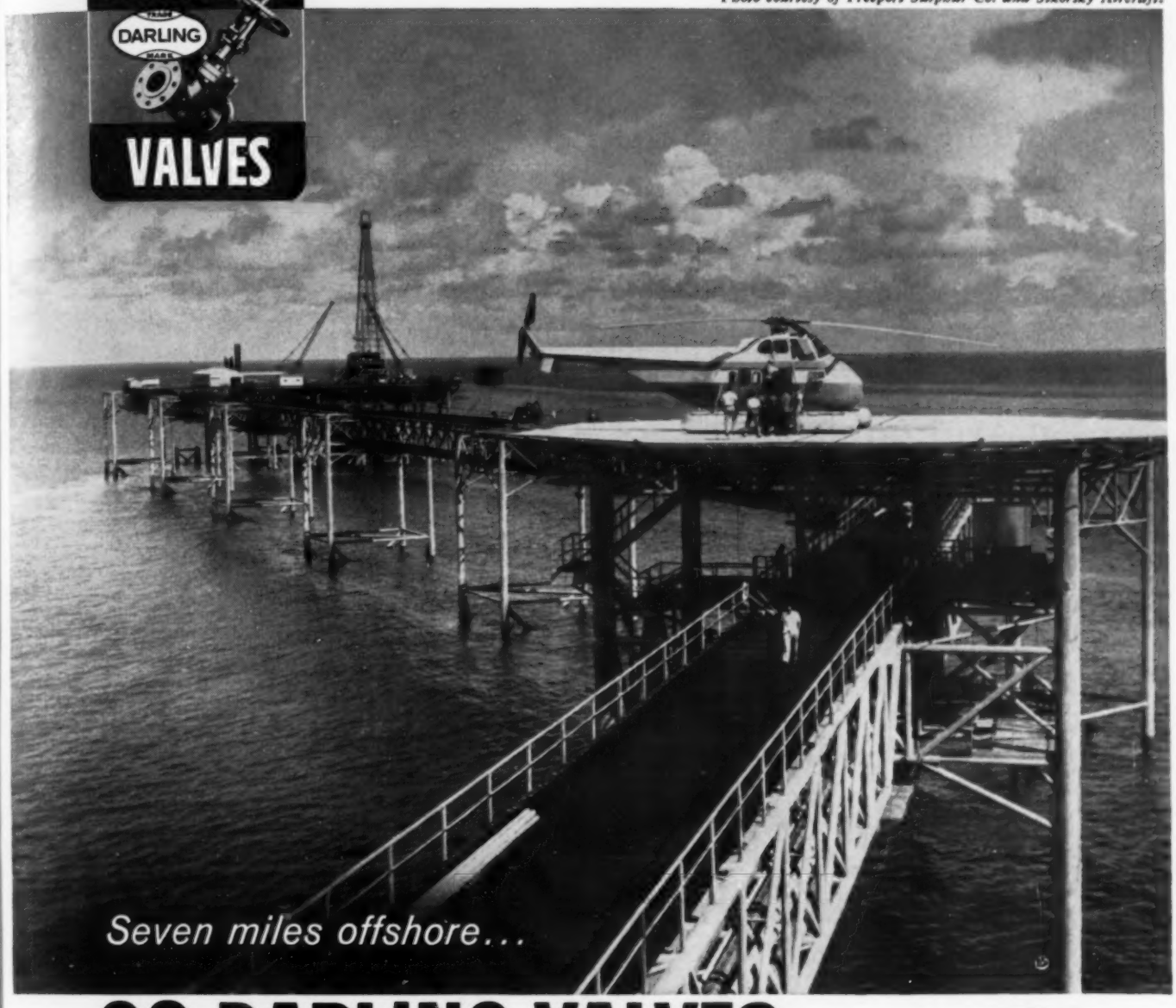
Indexed by Engineering Index

DARLING VALVES

Photo courtesy of Freeport Sulphur Co. and Sikorsky Aircraft.



90 DARLING VALVES

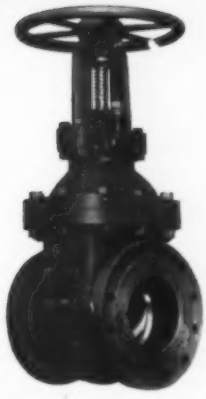
to help tap new sulphur deposit

Above you see part of Freeport Sulphur's $30,000,000 project to tap a major new sulphur deposit. It's the world's first offshore sulphur mining plant at Grand Isle... seven miles off the coast of Louisiana in the Gulf of Mexico. Production is planned to start in 1960.

Valves on the mile-long "steel island" mining plant were supplied by Darling. They include 2" to 12" OS and Y and 6" to 10" check valves made from Ni-Resist with monel trim . . . all for use in corrosive service.

Here's another case where Darling's extensive research and development on corrosion-resistant valves helped solve a specialized operating problem. And on gate valves, Darling's *exclusive revolving double disc parallel seat feature* assures positive sealing and ease of operation at all times.

Let us assist *you* on applications where "just ordinary valves" won't do. Write or phone us about your valve requirements. Or we'll gladly have a Darling sales engineer call.



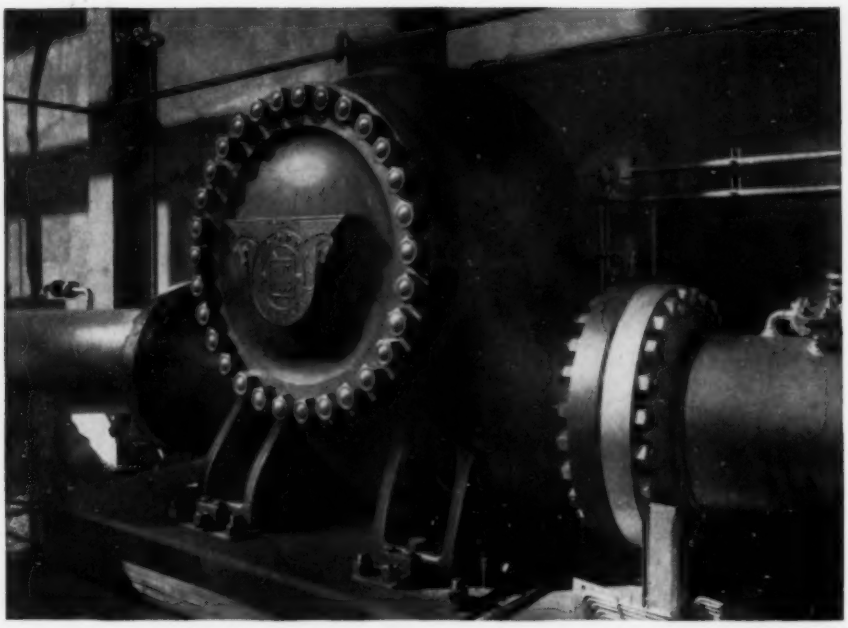
Darling OS and Y gate valve with flange ends . . . one of types being supplied for Freeport Sulphur's Grand Isle sulphur mining plant.

DARLING VALVE & MANUFACTURING CO.

Williamsport 27, Pennsylvania

Manufactured in Canada by Sandilands Valve Manufacturing Co., Limited, Galt 19, Ontario

For more data on advertised products, use Readers' Service Cards, last page.



Cooper-Bessemer RFB-24 centrifugals, like this one, powered by Cooper-Bessemer LSV turbocharged gas engines, comprise the world's most efficient pipeline compressor units.

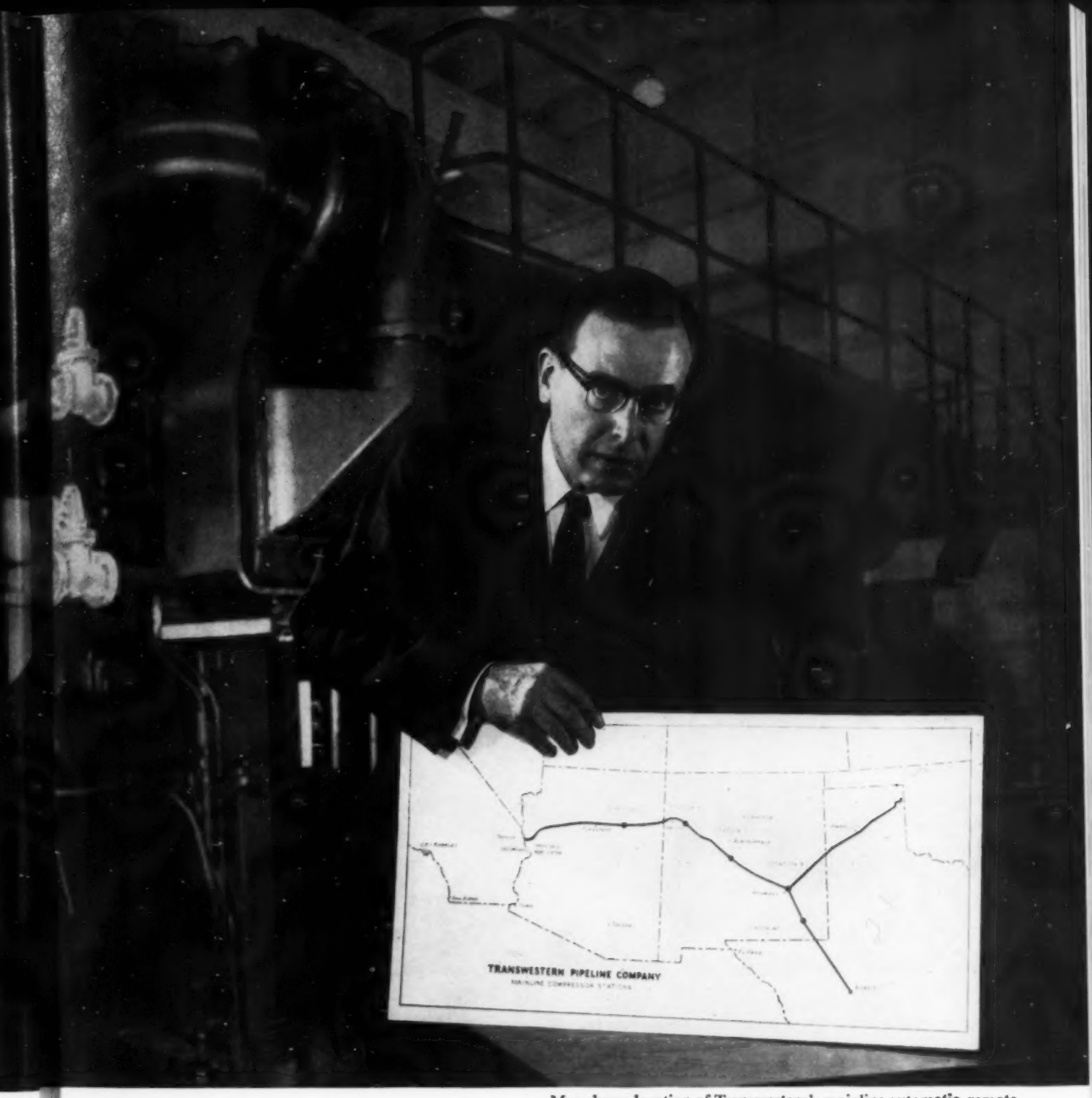
David M. Salls, *Manager, Gas Industry Sales, The Cooper-Bessemer Corporation, explains...*

How 5 Cooper-Bessemer powered, Gulf Interstate engineered stations will give Transwestern peak economy and flexibility

ALL FIVE of the mainline compressor stations of the new Transwestern Pipeline system will be equipped with Cooper-Bessemer engine-driven centrifugal compressors and will be remotely operated. These new automatic, remote-controlled stations will provide unexcelled efficiency and flexibility... a fact proven by the highly successful performance record of this modern equipment in other mainline stations of the same basic design—over 130,000 horsepower to date in mainline service.

The giant Cooper-Bessemer LSV-16 turbocharged gas engines will be of the type shown here. They will drive Cooper-Bessemer RFB-24 centrifugal boosters through speed increasers. Each of the five stations will include two of these high-efficiency compressor units. These units have the highest thermal efficiency obtainable in the gas industry today. The map shows the location of the stations. All units will be automatically controlled from a central point.

We will gladly supply details on this Cooper-



Map shows location of Transwestern's mainline automatic, remote-controlled stations. Background shows type of Cooper-Bessemer LSV-16 turbocharged engines to be used on this new line.

Bessemer equipment, and assist in *your* compressor station plans.

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by C. B. Lester

Let's examine the word "Leadership" and what it means to the user of any product.

Leadership is positive proof of **superior performance.** How else would you explain the preference that creates leadership?

Leadership identifies a manufacturer who keeps pace with the changing needs and conditions of his customers, and a product that embodies the latest advances in design and construction. How else can leadership be maintained?

GASO's leadership in its field, stretching over a period of 44 years, is built on a foundation of experience, concentration, research and service, all leading to the kind of performance exacting users look for in pipe line and water flooding operations.

This and this alone explains why Gaso Pumps are a standard specification in the buying policies of so many progressive oil industry companies.

May we send you our latest catalog?

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GASO PUMPS
for every oil industry need

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Here at last is a *one-source* corrosion-fighting team that has everything you've asked for in protective pipe coatings! The new CORR-PREV Tape Coating Team is a complete package of pipe protection — *including* the high-speed wrapping machinery! It features two basic components:

Chasekote*

Polyethylene Tape A pressure-sensitive protective tape coating of tough, inert polyethylene — unequalled as a pipe protection barrier against water, galvanic and chemical corrosion. Has an *extra-heavy* adhesive mass for fast, permanent tape-to-metal bond . . . 100% interface contact . . . self-sealing at the lap.

Chasewrap*

Abrasion-Resistant Overwrap A flexible, wrinkle-free overwrap material that effectively shields against backfill and soil stress damage. Wraps simultaneously with tape. Superior to rag and felt wraps, yet lower in cost.

Test this new CORR-PREV Tape Coating Team on a section of your own pipe. It's quicker, simpler, cleaner to apply. CHASEKOTE and CHASEWRAP go on right from the roll . . . factory-uniform in quality and thickness. You get longer-lasting pipe protection at *lowest applied cost.*

Moreover, it's a proven fact; CORR-PREV polyethylene tape coatings require *less than one-third* the cathodic protection current demand of conventional hot coats!

Oil & Gas Transmission Lines

Public Building Lines

FREE! Sample Rolls of CHASEKOTE and CHASEWRAP

*Trade name of Chase & Sons, Inc., long-famous for protective and insulating tapes for electrical wire and cable.

Refineries & Gathering Systems

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Highway and Airport Conduit & Pipe

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MAIL COUPON TODAY!

Chase & Sons, Inc., CORR-PREV Division
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Gentlemen:

Please send me FREE sample rolls and complete information about your new CORR-PREV Tape Coating Team — CHASEKOTE and CHASEWRAP.

Name.....

Title.....

Company.....

Address.....

City.....*State*.....

For more data on advertised products, use Readers' Service Cards, last page.

HERE'S ANOTHER REASON WHY
FORD TRUCKS ARE YOUR BEST BUY!

"REGARDLESS OF THE TERRAIN— MUD FIELDS... SAND... SWAMP BEDS—WE DEPEND ON OUR FORDS TO DO THE TOUGHEST JOBS"

SAYS ARNOLD J. LEWIS, MAINTENANCE FOREMAN, FARM BUREAU OIL COMPANY, INC., MT. VERNON, INDIANA

"Our trucks can be found anywhere within a 250-mile radius of Mt. Vernon transporting men and equipment needed for every phase of the oil business. We usually put our 28 Ford Trucks on the toughest jobs because we can depend on them to keep going even if they have to winch themselves out.

"The performance of our Fords is truly outstanding, when you consider that many of our jobs take us along river banks and through plowed fields with mud axle-deep.

"The engines are used just as much for winching and driving other equipment during field operations as they are for highway driving. In two years we get up to 140,000 engine miles on our Fords before we trade them in. During that time we change the oil and oil filter every 2,000 miles and seldom add any oil between changes.

FORD F-600 shown above has a special utility bed designed and built in the Farm Bureau Oil Co. shop. It features a power driven pipe-threading attachment, heavy-duty winch, gin poles, headache rack, rolling tailboard, two-way radio plus both arc and gas welding equipment.

FORD TRUCKS

"In this connection I might add that engine and accessory maintenance is much easier on the newer Fords since they have enlarged the engine compartment.

"Excellent parts availability is another reason why we use Ford Trucks on our toughest jobs ... and we can always get Ford parts at a reasonable price.

"We haven't bought any '60s yet, but it appears that Ford has many new and improved vehicles to choose from and I am sure that we will be purchasing them as we have in the past."

Big Fords for '60 are built for longer life . . . with Certified Durability!

Whatever your job . . . wherever you do it . . . you'll discover just as Mr. Lewis did, that Ford Trucks are the best investment you can make for your transportation dollar.

Certified results of tests conducted by America's leading independent research organization* confirm the fact that Ford Super Duties have been refined for added durability! For example . . .

Automatic radiator shutters reduced the coolant temperature variation recorded in severe mountain road tests from a 79° range to a 20° range. Engine operation with coolant temperatures in the 167° to 187° range means less expansion and contraction, more efficient combustion and better lubrication . . . all of which contribute to longer engine life.

Dynamometer tests showed *no vapor lock* with Ford's submerged-type electric fuel pump at temperatures up to 200°. Incipient vapor lock with mechanical fuel pump resulted in a power loss of 9% under the same conditions. Shaker table tests plus constant exposure to oil, water and heat proved 1960 wiring harness to be *three times longer lived.*

Test results plus the experience of satisfied users are important, but that is not all. For 1960, the Super Duty line has been broadened to provide even more flexibility in power train options. See your Ford Dealer!

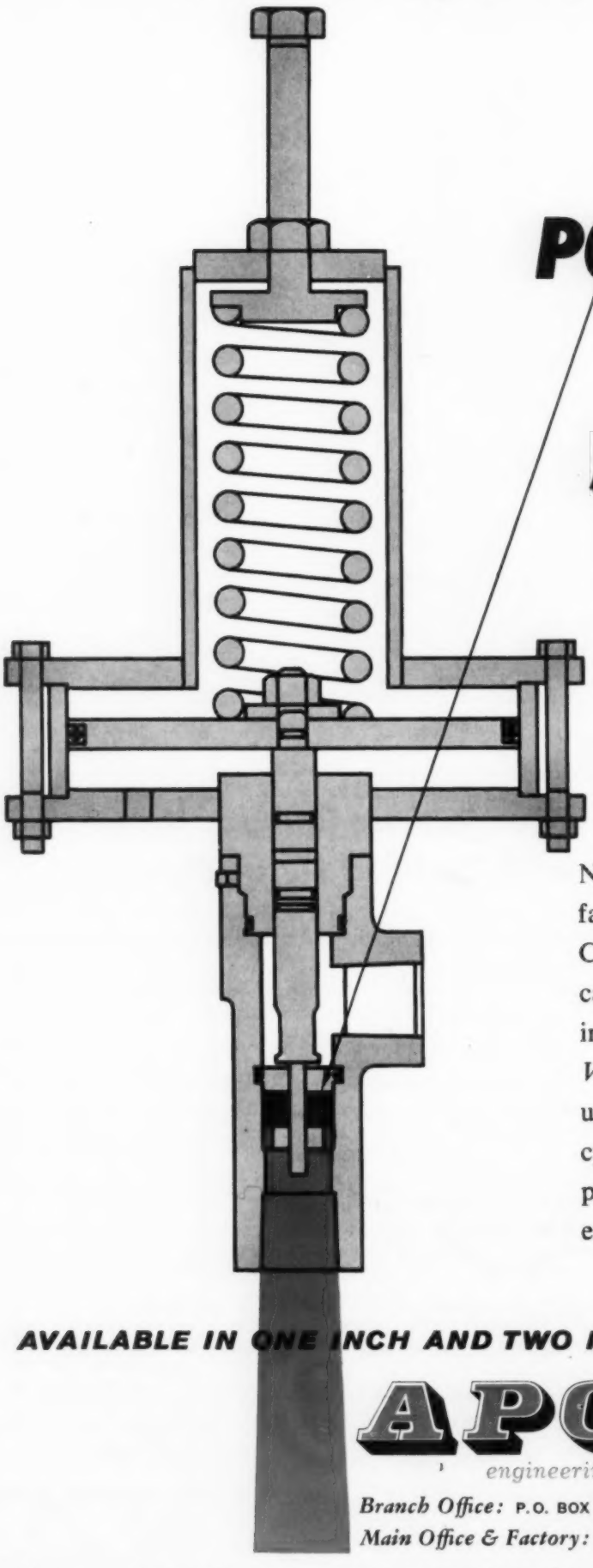
**Name available on request*

COST LESS

LESS TO OWN . . . LESS TO RUN . . . BUILT TO LAST LONGER, TOO!

For more data on advertised products, use Readers' Service Cards, last page.

Here's a liquid dump valve with...

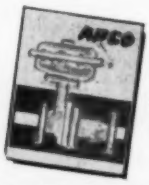


POSITIVE SHUT OFF *that* STOPS LEAKAGE

The Check-Stream DUMP VALVE

Now you can stop leakage, the major cause of failure in conventional dump valves, with the new Check-Stream Dump Valve. Even the smallest leak can cause an erosive action that can ruin your valve in a very short time. *The Check-Stream Dump Valve gives positive shut off* . . . it will not leak even under the most severe conditions. A solid rubber cylinder, expanded against the body liner by a piston motor, provides positive shut off as well as extremely fine throttling action.

AVAILABLE IN ONE INCH AND TWO INCH SIZES



Write today for Bulletin 25 giving complete specifications on the Check-Stream Dump Valve.

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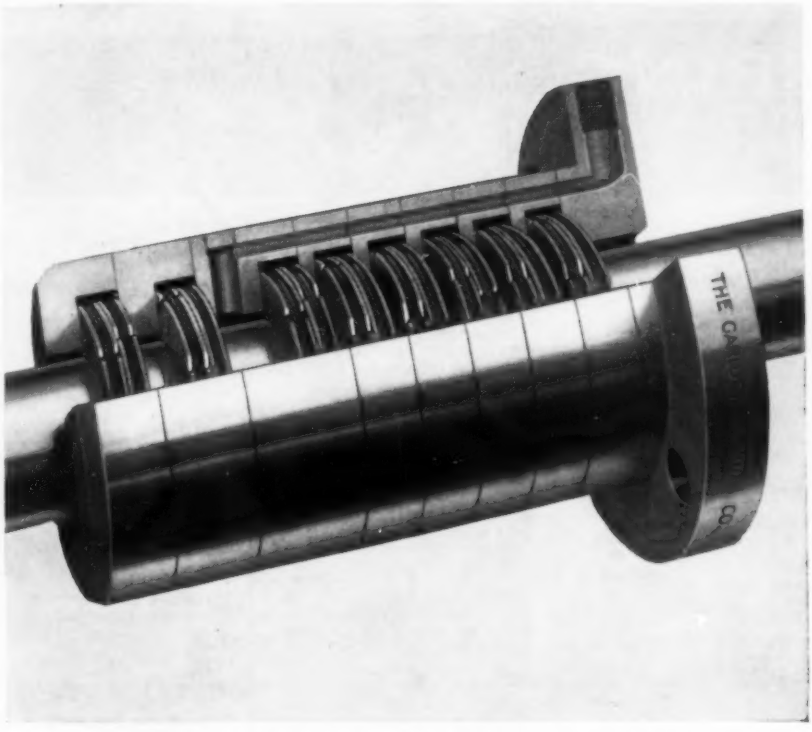
ENGINEERED PACKINGS for Pipe Lines



Garlock Metal Packings are supplied with segmental packing rings super-finished to 10 micro-inches or less for better sealing

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Garlock Metal Packings assure you of long-lasting, leak-free sealing at automatic stations hundreds of miles away. Once installed, metal packings can be forgotten . . . give you years of trouble-free operation!

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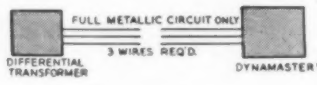
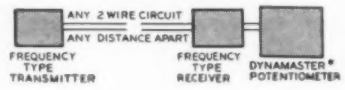
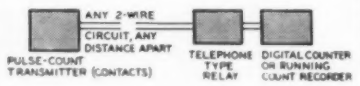
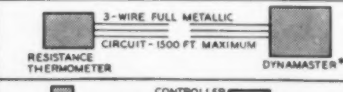
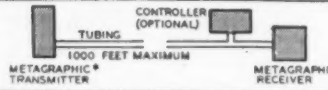
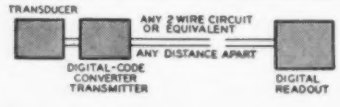
TIPS ON INDUSTRIAL TELEMETERING

for pipe lines, utilities, and process industries

TYPE	OFFERED BY BRISTOL	SIMPLIFIED BLOCK DIAGRAM	ADVANTAGES AND LIMITATIONS	MAJOR USES
IMPULSE DURATION	Metameter*		Simple electro-mechanical device. Will transmit over wire circuit, carrier or microwave links. Offered in 60, 15, 5 or 2 second impulse cycles.	For analog transmission of all measurands.
VOLTAGE	Thermoverters* & Dynamaster.* D-C Transmission		Instantaneous transmission. Limited to full metallic circuits of 2000 ohms (2 wires) free of parisitic currents.	For analog transmission of electrical quantities.
	Differential Transformer Transmitter & Dynamaster. A-C Transmission		Instantaneous transmission. Limited to full metallic circuits. (3 wire.) Can operate into electronic control directly.	For analog transmission of mechanical measurands.
FREQUENCY	Frequency Type Transmitter & Receiver with or without Audio Tone. (RFL) Model with Dynamaster End Device		Practically continuous. For millivolt inputs or measurand to millivolt pick-ups. Will operate over wire circuits, carrier or microwave radio links.	Primarily for transmission of electrical measurands but may be adapted to non-electrical quantities where high speed transmission desired.
PULSE COUNT	Transmitter — Contact Making Device. Receiver — Relay Operated Magnetic Counter or Running Count Recorder		Simple. Will transmit over wire circuit, carrier or microwave link.	Primarily for total flow transmission. Not used for instantaneous flow.
POSITION	Dynamaster Resistance Thermometer System		Instantaneous Transmission. Requires 3 wire metallic circuit not exceeding 1500 feet.	Temperature measurements.
PNEUMATIC	Metagraphic System. Metavane* System		Limited to 1000 feet of ⅛" tubing. Can operate into pneumatic control directly.	For non-electrical quantities where pneumatic transmission desired.
DIGITAL	Bristol Servo Transducer with Westinghouse, G. E., or Union Switch & Signal Pulse Code System		For transmission over wire circuits, carrier or microwave.	For digital transmission of all measurands, especially where pulse code supervisory control is available. Direct print-out of readings.

*T.M. Reg. U.S. Pat. Off.

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PIPE LINE PANORAMA

'60s Hold Great Promise for U.S. Pipe Lines . . . Tremendous strides in technology and construction are forecast for next decade, including the following PIPE LINE INDUSTRY predictions:

- Pipelining of LPG—growing number of slurries, i.e., coal, gilsonite, molten sulfur, grain, wood chips, salt—products to airports—and products to wholesalers near big city distribution points will increase rapidly.
- Gas pipe line construction will continue to outpace crude oil and products lines—4 to 1.
- Technological advancements will permit construction prices to advance at much slower rate than labor and equipment costs. In past decade, labor and equipment costs increased 65 to 100 percent, while construction prices remained comparatively stable. This trend will continue through 1969.
- With increased use of such instruments as seismographs and electrical surveys, uncertainties of hidden rock will be virtually eliminated.
- Also, there will be greater use of: **Double jointing on main line construction jobs . . . internal coating of gas transmission lines, with growing interest in internal in-place coating for large diameter lines . . . automatic controls for improved operation and economy . . . improved offshore equipment, including a fool proof way to detect underseas lines and new types of trenching machines . . . more compact, economical engines, i.e., rotary combustion, gas turbines, free-piston** (see page 48), **and battery or fuel cell-operated electrics.**

Ten-Year Impasse on Specifications for Pipe Line Railroad Crossings May Soon be Resolved . . . American Society of Civil Engineers group recently completed new set of specifications for pipe line and railroad crossings. It is hoped that this proposal finally will end 10-year impasse between ASCE, API, AREA, and highway groups on pipe line design and load specifications.

Thirty-five member ASCE committee, composed of representatives from all interested groups, will meet soon to see if full agreement can be reached, allowing specifications to be recommended for adoption by American Standards Association.

Will This Spawn New Hiring Trend? . . . Under old contracts (before present Referral Office), contractors had agreement with Local 798 business agents to hire 75 percent of their welders, taking the remainder from the Union. However, in recent weeks several jobs have started with contractors agreeing to hire 50 percent through the Referral Office and to select only 50 percent from regular employes.

Washington Panorama . . . Federal Power Commission has elected Arthur Kline to succeed William R. Connole as agency's vice-chairman during 1960 calendar year . . . **Missouri-Kansas-Texas Railroad** will build 2,500-mile LPG line from Texas Permian Basin to Wisconsin and Minnesota, to be completed next fall . . . **Natural gas producers are in a quandary following U.S. Supreme Court reversal** of authority granted 26 producers to sell gas to Transco. Case is now back in the lap of FPC for further price hearings. Meanwhile, producers have no idea what price will be paid for gas already delivered, or what price can be expected from future sales.

PIPE LINE INDUSTRY's Annual Survey Indicates . . .

27,419 Miles of Pipe Line Planned for 1960

Worldwide survey of 245 pipe line companies supports prediction for a record year in construction: U.S. gain to be 1,406 miles; increase for entire Free World—20 percent

By Melvin A. Judah, Editor
Donald G. De Pugh, Construction Editor
PIPE LINE INDUSTRY

THERE ARE MANY factors affecting the oil and gas pipe line industry that will temper the optimism of any pipe line prognosticator. They have been well reviewed in our guest editorial this month by John H. Williams, president of Williams Brothers Company and retiring president of the Pipe Line Contractors Association.

Even considering these and anticipating the usual ration of adversities that may well face the industry, PIPE LINE INDUSTRY's annual survey of all major companies operating crude oil, products, and natural gas pipe lines gives room for mature optimism. Perhaps the best indicator of the over-all outlook is found in close agreement between the mileage of U.S. pipe line construction forecast for 1959 at the beginning of the year and that actually completed. A total of 16,631 miles was predicted (see PIPE LINE INDUSTRY, January 1959, pages 24-25). The current survey shows that 16,277 miles of lines were actually laid.

Operating pipe line companies (and industry publication editors) are generally optimistic in their estimates of the amount of work proposed. Rate agreements, regulatory delays, financing arrangements, as well as the natural construction obstacles like weather make realists out of us at the year's end. So this prediction accuracy of "2 percent" is just about a "straight-A" on the industry's report card for 1959. It would take a strong dose of optimism to forecast that the "Golden Sixties" will be a greater decade for the pipe line industry than the "Fabulous Fifties," but from this report it appears they are starting off this way.

In the gas pipe line industry, the serious impact of the Memphis Decision is past; regulatory uncertainties persist—particularly with respect to rate-making policies. Those will act as a dampener in the coming year but the 1960 forecast of 14,524 miles of gas pipe line construction is a healthy gain over the 13,125 miles laid in 1959. Scheduled compressor additions of 513,460 horsepower represent about five percent increase over the 482,510 horsepower installed last year. Gas pipe line company

Forecast of Free World Pipe Line Construction for 1960

	UNITED STATES		FREE WORLD OUTSIDE U.S.		TOTAL FREE WORLD	
	1959	1960	1959	1960	1959	1960
NATURAL GAS LINES:						
Transmission Lines	9,717	10,619	2,571	2,647	12,288	13,266
Gathering Lines	3,408	3,905	814	1,060	4,222	4,965
Total Gas Lines	**13,125**	**14,524**	**3,385**	**3,707**	**16,510**	**18,231**
CRUDE OIL LINES:						
Trunk Lines	527	497	1,897	3,912	2,424	4,409
Gathering Lines	1,465	1,212	650	965	2,115	2,177
Total Crude Lines	**1,992**	**1,709**	**2,547**	**4,877**	**4,539**	**6,586**
PRODUCT LINES (Including LPG):						
Total Lines Main and Laterals	**1,160**	**1,450**	**525**	**1,152**	**1,685**	**2,602**
TOTAL ALL LINES	16,277	17,683	6,457	9,736	22,734	27,419

Forecast of Prime Mover Horsepower to Be Installed By Free World Pipe Line Companies in 1960

	UNITED STATES		FREE WORLD OUTSIDE U.S.		TOTAL FREE WORLD	
	1959	1960	1959	1960	1959	1960
COMPRESSOR DRIVES:						
Gas Engines	397,610	428,780	109,086	82,685	506,696	511,465
Gas Turbines	55,350	61,430	.....	49,300	55,350	110,730
Electric Motors	29,550	23,250	9,000	.....	38,550	23,250
Total Compressors	**482,510**	**513,460**	**118,086**	**131,985**	**600,596**	**645,445**
PUMP DRIVES:						
Electric Motor	40,245	34,870	26,725	30,350	66,970	65,220
Gas and Diesel Engines and Gas Turbines	15,048	10,955	22,960	43,040	38,008	53,995
Total Pumps	**55,293**	**45,825**	**49,685**	**73,390**	**104,978**	**119,215**
GRAND TOTAL	**537,803**	**559,285**	**167,771**	**205,375**	**705,574**	**764,660**

reports indicate that 1960 will be more of a pipe line looping year than one of big station construction programs.

Crude Oil Lines Down—Products Up. Although the total of all oil industry pipe lines proposed for 1960 is about the same as for 1959, the relative inactivity in crude line construction reflects the industry's domestic problems and the excess capacity available in the nation's trunk line systems. A gain of 290 miles in planned products line construction balances the crude line drop. Of special interest last month was the news report that another railroad, Missouri-Kansas-Texas, was well ahead with plans to lay an LPG line from West Texas to Wisconsin and Minnesota. Several railroads in recent years have expressed active interest in petroleum pipe lines particularly products systems. Southern Pacific Pipe Lines has been operating two highly successful systems for more than two years.

Pump station additions for crude and products systems show a drop for 1960 with 45,825 horsepower installations planned compared with 55,293 in 1959.

International Pipelining Sets Brisk Pace. Reports from 71 operators of pipe lines outside of the United States (and, incidentally, outside the Iron and Bamboo Curtains) show an amazing gain in pipe line construction with high activity in Europe, Canada, and North Africa. More companies reported than ever before, and in much greater detail than in previous annual surveys.

Free World pipe line projects call for construction of 9,736 miles in 1960, an increase of 50 percent over 1959 when 6,457 miles were laid. Crude oil line projects make up a big share of this total; 4,877 are proposed as compared with only 1,709 scheduled in the U.S. Products line work outside the U.S. shows an increase from 525 miles in 1959 to 1,152 scheduled for this year. The gain in gas pipe line work is modest: up to 3,707 miles from 3,385 in 1959.

Horsepower additions to Free World pipe line systems are slated to increase too. A total of 205,375 horsepower of all types is planned as compared with 167,771 installed in 1959.

All Major Operating Companies Polled. Figures summarized in the accompanying tables are based on PIPE LINE INDUSTRY's survey of all major pipe line companies operating in the United States and abroad. In addition to mileage of line completed or planned by class service, our survey forms also sought the diameter, breakdown of lines by service and horsepower additions by type prime mover. The 174 companies who operate the bulk of U.S. pipe line system mileage were included in the summary. Results of the survey are very complete; virtually every company responded. They told PIPE LINE INDUSTRY editors, in confidence, how many miles of lines they laid in 1959, diameters of pipe, station horsepower additions, type prime mover and their plans for 1960. In summarizing, estimates were made of the activity of a few companies who did not report, but who had previously announced completion of projects in 1959 or their plans for 1960.

This survey does not include gas distribution lines laid within corporate city limits, field flow lines, conversion of lines from one service to another, or reconditioned line mileage.

These forecasts cover pipe line and station projects completed in 1959 and those planned for 1960. They do not reflect total mileage placed in service in 1959 but started in earlier years nor mileage of all projects that will be started in 1960 which will be completed in later years. Such mileage would be included in the report of that year's construction.

Forecast of Diameters to Be Used in Construction Projects

Nominal Diameter (Inches)	U.S.		OUTSIDE U.S.	
	1959	1960	1959	1960
2–4	2,181	1,835	454	508
6	1,458	1,085	513	729
8	1,229	1,266	436	997
10	791	955	402	612
12	1,312	1,492	675	1,312
14	307	371	44	308
16	1,280	1,371	237	1,508
18	404	470	76	300
20	1,431	1,069	250	657
22	146	200	160	....
24	1,945	1,713	1,751	900
26	459	423	....	....
28	....	....	50	....
30	1,097	2,010	754	723
32	....	....	90	474
34	....	619	....	9
36	71	1,549	....	267

Total of all diameters not equal to industry total, as some reporting companies did not show breakdown by pipe diameter.

—The End

New Ideas Highlighted Construction in 1959

Costs of labor and equipment continue to rise, but the price per foot for pipe line construction has advanced very little. How are contractors able to make out? By striving toward greater efficiency, better planning and a flood of new ideas. Here are some of the top ideas that cropped up in 1959

By Melvin A. Judah, Editor
Donald M. Taylor, Engineering Consultant
PIPE LINE INDUSTRY

THE COSTS of labor and equipment have increased 65 to 100 percent in the past 10 years! The welder who earned $2 per hour on the Texas Gulf Coast in 1949 now earns $3.55 an hour. During this same decade, wages for common labor in the same area have advanced from the 60-cent-to-$1 range to $1.40—$1.70.

What about equipment costs? They have followed the same pattern, although specific items have not advanced at all. Too, it should be pointed out that much of the equipment has increased in efficiency, horsepower and mobility along with price increases.

But what about contract prices? Have they advanced to keep up with these increased expenses. How are contractors offsetting these higher costs?

Generally speaking, the price of pipe line construction has increased on the order of 15 percent. Contractors interviewed on this subject pointed out that several times in the past 12 months they have been forced to submit bids identical with those of 10 years ago. For the most part, bids today are 5 to 30 percent higher than those in 1949.

Why haven't prices risen with expenses? For the simple reason that competition has become severe, and contractors have to bid low to get jobs. And in the face of these lowering prices, contractors have had to pick up efficiency to stay on the black side of the ledger.

They have managed to do this by hiring mechanical and civil engineers, placing them in key posts in their organizations. In addition, they have warmed toward new ideas which come from these technical men, and they spend more time planning jobs.

For the past seven years, PIPE LINE INDUSTRY and its parent magazine WORLD OIL have listed in January issues the new developments in pipe line construction that have come during the preceding year.

The list of new techniques grows larger each year, despite the simplicity of the pipe line task—welding the pipe together, coating it and covering it up in the ditch.

Here are some of the new ideas and developments that were used in constructing pipe lines during 1959.

New Ways to Detect and Analyze Subsurface Rock

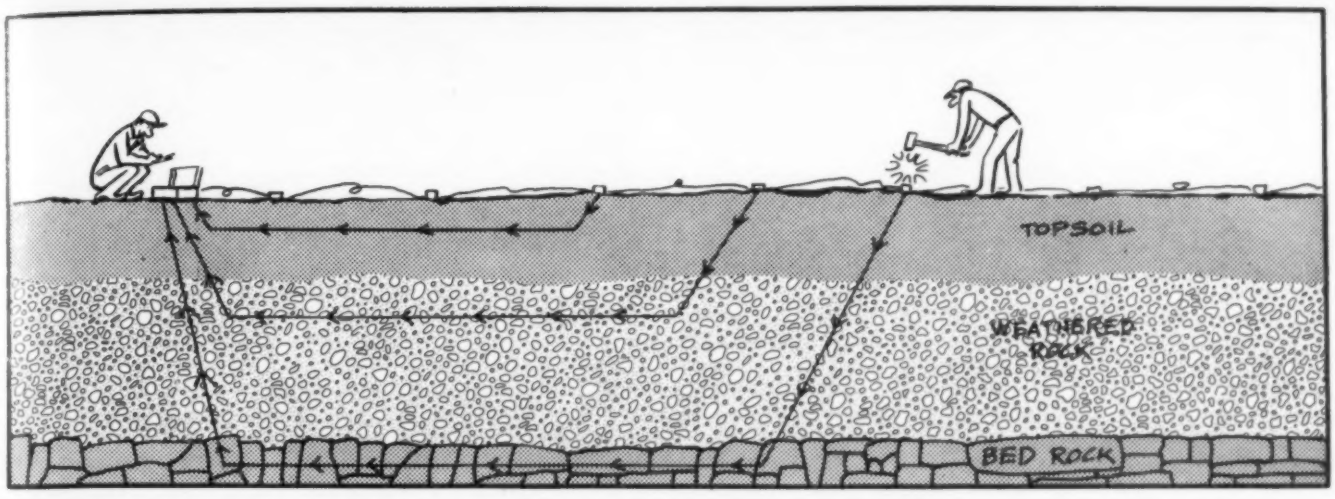
Two great uncertainties account for most business failures among pipe line contractors. In order of the devastation they bring, they are: weather and rock.

Long-range forecasts are taking care of some of the uncertainties in weather and two new scientific advances are doing a great deal to shed more light on underground rock.

Just what does a contractor need to know before bidding a job in an area where rock is involved? He needs to know: How much rock? How deep? Can it be ripped with a tractor or must it be drilled and blasted?

Two instruments developed during 1959 will go a long way toward taking uncertainties out of hidden rock. One of them is based on the seismograph principle long used by geophysicists to search for underground structures which might trap oil. The other method is based on electrical resistivity of the earth.

RIP THE UNDERGROUND ROCK? A new method of surveying underground rock with a seismograph set-up was devised by a tractor company's engineering department. It shows the depth of the rock and whether or not it can be ripped rather than drilled and blasted.



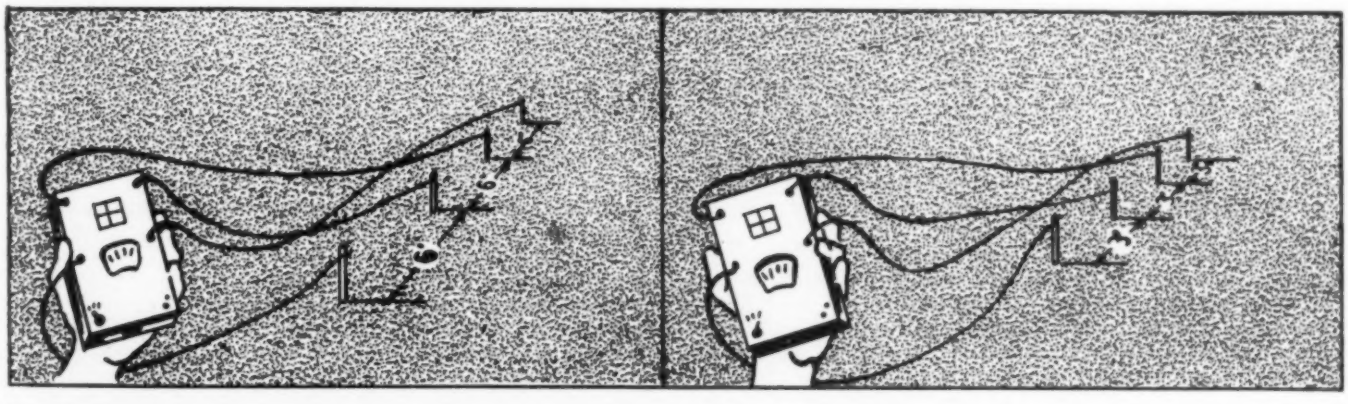
How the seismograph method of rock determination works. Sound from the sledge striking the steel plate is recorded as it travels along the ground and as it echoes from rock beneath the ground. Because different rock reflects at different speeds, etc., this instrument makes it possible to determine the characteristics of rock as well as depth.

Seismograph Gives Reliable Information on Underground Rock. A $3,000 instrument set-up is providing the best means of determining the depth and consolidation of underground rock. The instrument is simple to run. Two reliable men can become proficient with it in an hour's time.

Here's the way it works. One of the operators measures off a distance from the recording device—this usually is done in 10-foot increments—and places a small steel plate on the ground. After checking electrical connections and distances, he draws back an 8-pound sledge hammer and whomps the steel plate.

This introduces a sharp front of sound which travels directly along the ground and also which radiates downward to be reflected upward. The recording device times the sound wave's travel along the surface of the ground and its devious route as well. By comparing the two speeds, measured from various distances, and checking the results against tables based on research data, the depth of the rock and its hardness and consolidation can be determined accurately.

For more details on this subject, see PIPE LINE INDUSTRY, December 1959, pages 32-34.



Read the resistance of the earth from copper rod electrodes spaced at different intervals. When the spacing between the electrodes is as far apart as the hidden rock is deep, there is a sharp increase in resistance.

Electrical Survey Can Detect Underground Rock. A second method of finding the depth of subsurface rock was developed by the Michigan State Highway Department. The equipment layout costs about $700 and it takes little or no experience to run the survey. As shown in the illustrations, copper rods are driven in the ground at various spacing, and the resistivity of the soil is read. By plotting the resistance readings and noting increments, it is possible to determine the depth of the rock. For a more thorough explanation of this method, see PIPE LINE INDUSTRY, April 1959, pages 43, 44 and 51.

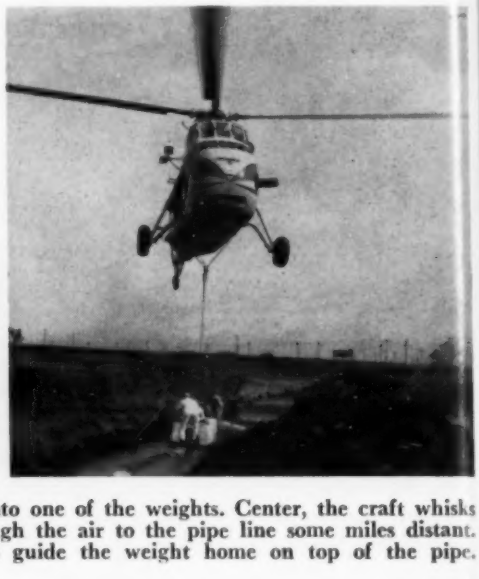
Using a Helicopter for Pipe Line Construction

When helicopters became available for commercial use, pipeliners nabbed on to them. They have used them to ferry supervisory personnel and light parts along the right-of-way. In marshland, pipeliners used the whirlybirds for survey work, dragging 1,000-foot chains and hovering to establish PIs.

But the first company to actively use the sky-hook for honest-to-goodness construction was Northern Natural.

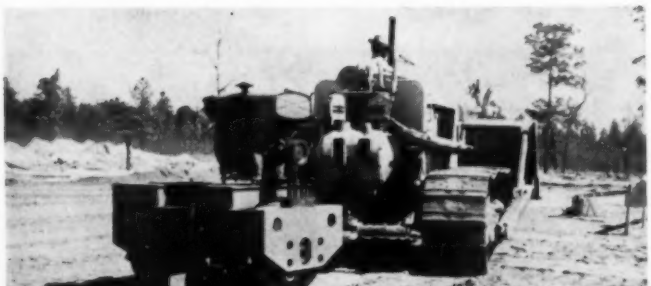
When constructing a line through a 60-mile stretch of Minnesota swamp land, the helicopter was used to pick up 3,000-pound weights and place them on the line. An engineer rode the craft to direct spacing. Two pipeliners were used to hook on the weights, two to unhook them. A total of 2,700 weights was used on this stretch of line.

For more details on this subject, see PIPE LINE INDUSTRY, March 1959, page 61, and October 1959, page 56.



Here's the sky-hook! It's the S-58 helicopter which placed the 3,000-pound concrete weights on Northern Natural's line in a Minnesota swamp for $25 per weight. Normally the cost would have run between $65 and $70. At left, hook the wire rope from the helicopter onto one of the weights. Center, the craft whisks the weight through the air to the pipe line some miles distant. Right, pipeliners guide the weight home on top of the pipe.

Compacting Soil at Compressor Station Site



Gasoline-powered eccentric weight imparts high speed vibration to the ground through the roller. This proved effective in stabilizing soil for station construction in parts of Florida.

On the Houston Texas Gas and Oil Corp. line that runs from Baton Rouge, La., to Miami, Fla., stable soil for station sites was a problem in parts of Florida. For most of these questionable sites, the company had a testing laboratory core the soil to depths of 30 feet. Where load curves indicated it was needed, the station yards were stabilized by a vibrator-roller pulled behind a bulldozer. A gasoline engine powered a rotating eccentric weight which imparted high-speed vibration to a heavily loaded roller. See PIPE LINE INDUSTRY, May 1959, page 23.

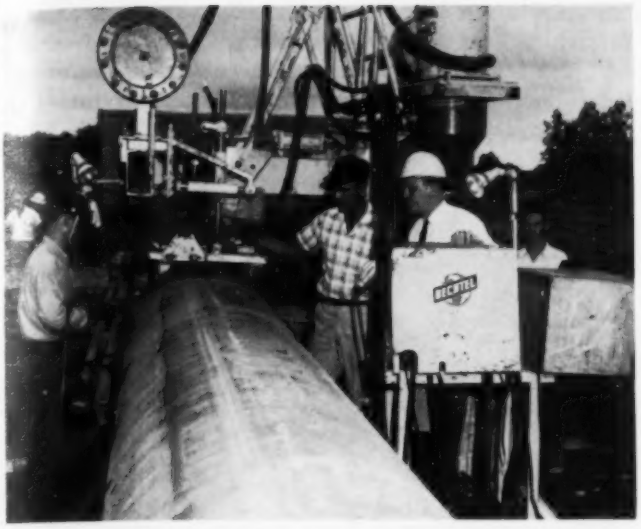
Double Jointing Techniques Improve

The double jointing yard is essentially nothing more than a move to prefabricate sections of the pipe line under an environment conducive to more efficiency than that on the right-of-way. Any way you look at it, "the weld's the thing" in pipelining, and if you can set up a double jointing yard and complete half the welds using automatic welding equipment, you can save money.

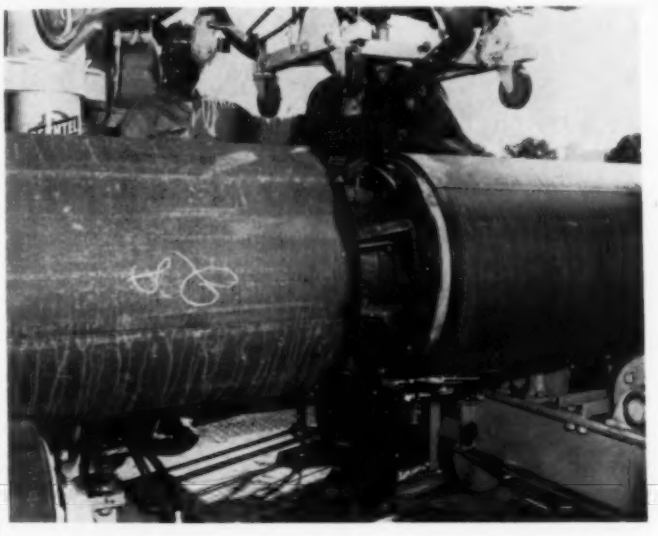
Contractors have been setting up double jointing yards for the past 10 years. Until recently they were primarily manual operations. But during 1959, two different companies perfected portable yards with automatic welding and semi-automatic line-up and pipe handling. This year, these portable "yards" really swung into action on many large diameter pipe line projects.

How did they work out? Using a labor force of about 15 men, one of the pipe yards produced 120 to 130 double joints per day, using two welding stations. As a rule, these yards produce about 85 welds per day using one station.

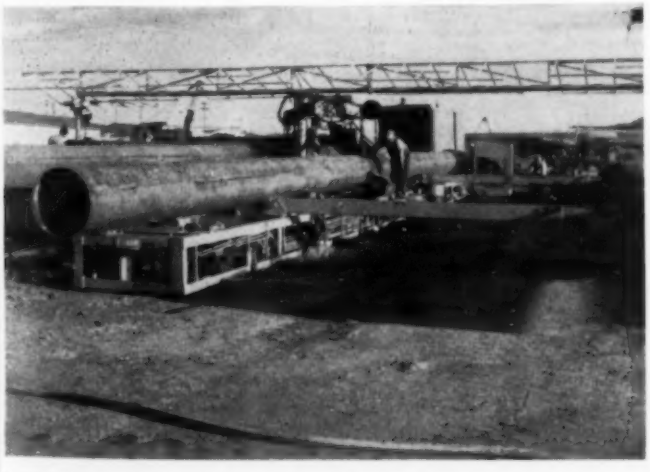
Generally speaking, the two automatic welding yards are similar. The pipe racks, line-up equipment and welding equipment are readily portable, and the yard can be moved from railhead to railhead to follow the work.



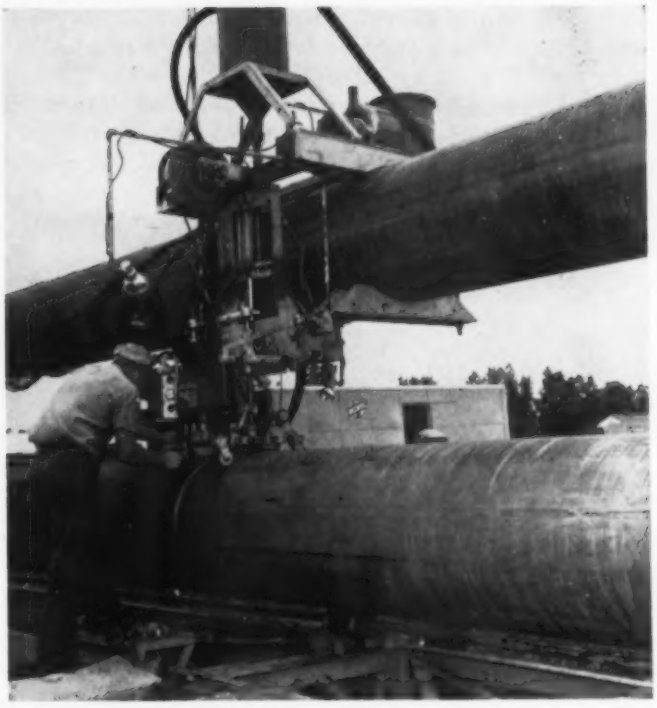
Automatic welding, push-button controlled in a double jointing yard. The submerged arc head floats to maintain alignment. The spool over the pipe feeds the weld metal and a hopper above it supplies the flux.



Pneumatic line-up clamps. Note the band of white fiber glass which backs up each weld. This eliminates need for an inside stringer bead.



The H. C. Price Company double jointing yard in Arizona. Virtually all of the operations are actuated by pneumatic instruments and rams. When two joints of pipe reach the welding station they are lined up by pushbuttons, and the weld is made automatically.



Second stage in a two-jointing yard which turned out 120 to 130 welds per day. The upper pipe, simply acts as a structural member to support automatic welding equipment at second station. Spent flux is reclaimed beneath weld and re-used.

The Bechtel Yard. The key piece of equipment is a line-up clamp with segmented copper shoes which press outward against the pipe. Before each line-up, this shoe is covered with fiber glass to prevent weld metal from combining with the shoe. This unit does not require manual welding of any kind. The weld is completed in two submerged arc automatic welding passes externally. Flux feeds onto the weld from an elevated hopper and weld metal spools into the weld as needed. Excess flux is collected and re-used.

The entire line-up task is accomplished by pushbuttons. One of the interesting features of the unit is the automatic dog-leg compensator which holds a fixed gap as the joints are welded. For more details, see PIPE LINE INDUSTRY, February 1959, page 38.

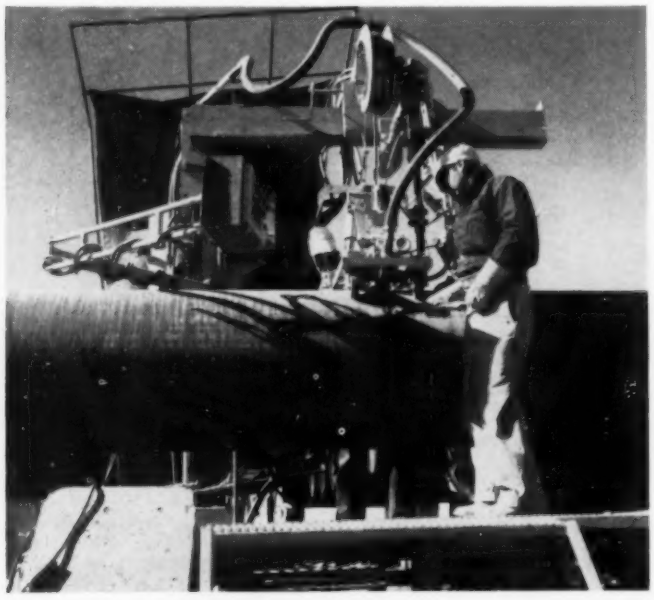
The Crose-Price Yard. This yard is similar in many ways to the other yard. The unit has built-in vertical and horizontal pipe positioning by means of pushbutton controls, and the internal pneumatic line-up clamps take care of most of the "out-of-roundness." The welding head is free-floating.

Prior to making each weld, some 75 percent of the standard 30-degree pipe bevel is removed with grinding tools. Once the weld has been completed, a welder enters the pipe on a boom and welds the stringer from the inside.

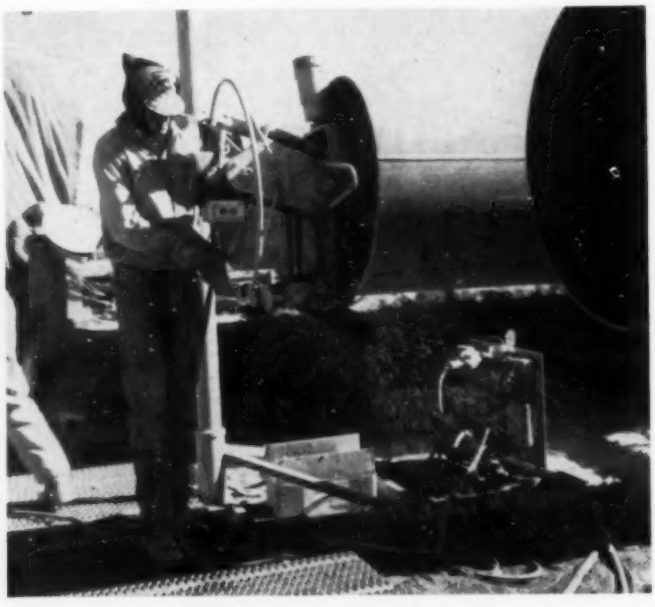
Things Both Yards Have in Common. In nearly every instance, the owner companies have requested that all welds be X-rayed. Results prove that the welds have been excellent. From the contractor's viewpoint, the yards

have paid out. Although each requires some 12 to 15 men, the premium priced labor is at a minimum.

Special Precautions for Double Jointing Internally Coated Pipe. One of the big trends during 1959 was toward internally coated pipe. Nearly all of this coating has an epoxy resin base which generates gas when heated to welding temperatures. This gas may prove toxic if exposure is sufficiently intense. In any event, the gas can enter the weld and cause porosity. For this reason, all of the yards have the coating buffed back one-half inch from the weld to prevent its formation.



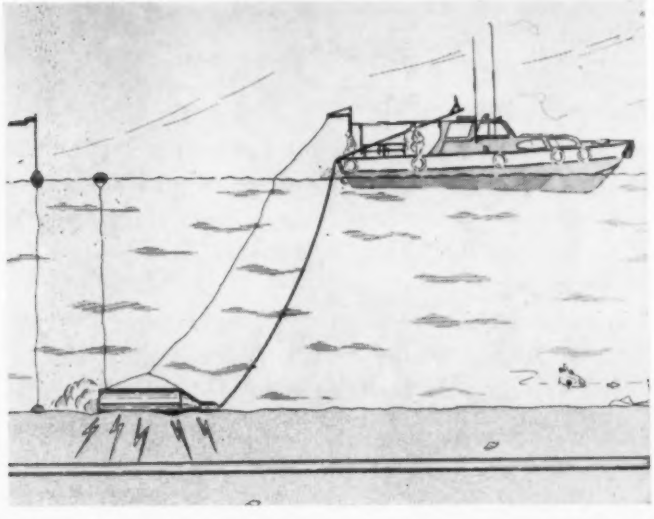
Close-up of automatic welding operation in Houston Contracting Company's double jointing yard in New Mexico. Note the pushbuttons on the arm at the left which are used to line-up pipe. Weld metal feeds from the spool at the top; flux feeds through the hose.



Grinding the pipe bevel prior to automatic welding operation. This process requires that about 70 percent of the 30 degree bevel be ground off to make a "J" bevel which will go with this operation. The lands on the bottom of the "J's" actually butt against one another.

Locating Buried Undersea Pipe Lines

Several years ago a contracting firm and an owner company spent almost six weeks unsuccessfully trying to locate a line they had laid in the Gulf of Mexico only a few months earlier. Why the difficulty? First the right-of-way is difficult to distinguish from the rest of the salt water. In addition, the lines sometimes move after they are laid!



Schematic showing new pipe line locator being towed by light craft. This new electronic metal locator, cannot only find pipe lines, it can accurately determine depth provided the diameter of the line is known. The instrument generates an electromagnetic field which records any interference.

When Shell Oil Company started experiencing difficulties along these lines—the company has some 350 flow lines in their operating area, not to mention those owned by other companies—Shell Development Company was called in to provide a solution. The latter came up with a 200-pound, six-foot-long "fish" which is dragged along the ocean floor and used very much like pipe locators used on shore.

The electronic locator makes a permanent record of ferrous metal objects in its path. Moreover, the equipment is calibrated to enable the operators to determine the depth of the burial.

Basically, the instrument operates on a principle similar to that of one of the popular pipe locators used on land. It generates an electromagnetic field and when this field is disturbed, as when a pipe comes within its scope, the disturbance is indicated on shipboard.

What distinguishes this locator from others? First, it works in salt water. Most commercial models react to salinity with confused readings. Because of special innovations, the Shell locator reduces such interferences to a minimum.

Second, the new locator can measure the depth of the pipe to within 6 inches, provided the size of the pipe is known. Three-inch pipe lines have been spotted accurately at 6 feet under silt and a 20-inch line was located at 7 feet.

Third, the locator hook-up makes a permanent record, and if the instrument is used in conjunction with some

geographic surveying system, it can map a line.

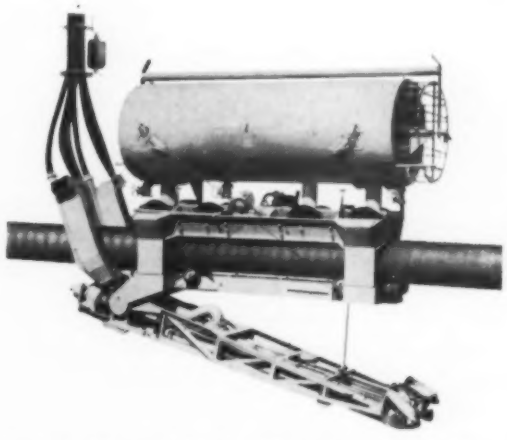
Two of these instruments have been used for about a year by two of Shell's crews operating out of New Orleans. On occasion, the locators have been helpful in pinpointing broken flowlines to eliminate extensive probing by divers. They have also been used to spot lines which lie in the path of projected dredging or pipe laying operations and to find points in lines that may break because the lines are sinking unevenly into the ocean floor. Preventive measures are then possible.

New Undersea Trenching Machine

A new undersea trenching machine tested last year off Cameron Parish, Louisiana, employs the same principles used in conventional dredges: it has a cutter head and a string suction which moves cuttings from the ditch.

Here is how the trencher works: the 28-foot-long cutter assembly arcs up and down as the machine moves along the pipe in hitches which comprise the right size bites for the counter-rotating cutters. High-pressure water from the surface motivates the eductors in the cutter head area to move the material out of the ditch to be deposited on either side.

Although the machine is remotely controlled from the surface, its depth limitation is that of a diver, because human hands are necessary in latching it onto the pipe and taking it off. This 15-foot high, 28-foot long machine can cut a ditch 5 to 15½ feet deep. (This unit was designed by John Pfeffer, consulting engineer with Rosson Richards of Houston.)



Undersea trenching machine, which measures 15 feet high and 28 feet long. The cutter-head arm below the pipe arcs vertically to cut the ditch ahead as the machine moves forward in hitches. Cuttings are carried out by eductors and deposited on the side of the ditch.

Dewatering Pipe Lines After Hydrostatic Tests with Spheres

By running 2 to 4 spheres to drive water from a pipe line after hydrostatic testing, not only can a great deal of motive gas be saved, but time can be saved as well. The spheres are pressured to be slightly oversized and the line has little or no water in it after the very first run.

For additional drying, methanol contained between two pigs can remove most of the water from the line. One of the advantages of the spheres is that they can turn short radius bends and they maintain a tighter seal against the pipe wall.

Spheres simplify water removal from tested lines. First, water is removed by driving spheres ahead of gas; then test section is dried with a slug of methanol contained between two spheres.

Muffle Furnaces Stress–Relieve Welds on Heavy Wall Pipe

To be effective, the Leidy Storage field in central Pennsylvania required wellhead pressures of 5,000 psi. This in turn required a gathering system of extremely heavy wall pipe: 12-inch—1.312 inches; 10-inch—1.125 inches, and 8-inch—0.906 inch.

The pipe was double jointed in a pipe yard, using the submerged arc method, and welded in the field after preheating. Each weld was heat-treated with portable muffle furnaces which simply circulate the gas flame in a tight annulus around the pipe. The temperature of the pipe

is raised slowly to 1,200° F, held at this temperature for one hour and 20 minutes and then lowered to 600° F for about one and one-half hours. The furnace fits over the pipe in two halves, in much the same manner as a river clamp.

It takes about 12 hours to complete a manual weld on the heavy wall pipe. Each weld is heat treated in the annealing ovens which direct gas flame around the pipe in a tight annulus.

New Coatings Simplify Construction

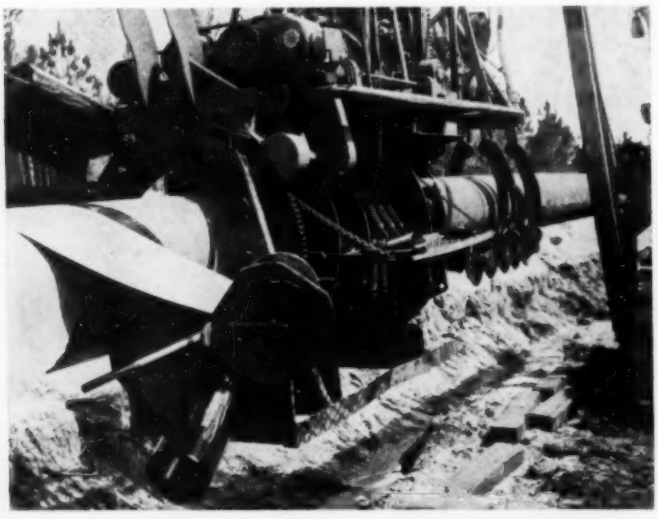
Two new coatings—tape coatings and thin-film coatings—are effecting major changes in pipe line construction. Both of them reduce labor and equipment requirements on the right-of-way, and, to a degree, both of them minimize delays caused by light rains.

The new thin-film coatings are applied at the pipe yard—only the weld area need be coated on the pipe line, and this can be done with a single wrap of tape coating.

The film type coatings are still in experimental stages; however, a number of coating manufacturers predict that they will come into their own in 1960. The most popular thus far in this category is the mixture of epoxy resin and coal tar. These coatings are chemically set up after application. Another coating falling in this category is a new asphalt-epoxy resin which according to its developers holds great promise.

Butoxy resins are applied to the pipe and set up with 500° F temperatures coming from a direct flame. All of these coatings cost more at this time than conventional coal tar or asphalt coatings.

Tape coatings have thus far proved profitable for the contractor. On 30-inch pipe they can be applied in the field for 15 to 20 cents per foot less than the cost of applying conventional coatings. They require about a third less labor, and less than half the equipment as a rule. Pressure-sensitive tapes can be applied with minimum delay after rains cease, and at least one contractor plagued with intermittent light rains, devised a means of drying pipe with air and heat, so coating operation would not be indefinitely delayed.



Tape coatings made appearances on many miles of big-inch gas lines this year. They required smaller crews of men and less down time after rains than conventional coatings.

Thin-film coatings mean less work for the contractors; however, there is one advantage—if pipe is shop coated, the rain cannot delay the coating work.

Aluminum Gathering Lines Unspooled Directly into Ditch

A method of laying pipe lines—almost an exact duplicate of the method used in Operation Pluto which spanned the English Channel in World War II—was demonstrated in Colorado recently

The entire operation was automatic. The ripper dug a 42-inch-deep trench, unreeled and laid two-inch schedule 5 aluminum pipe in it and backfilled the trench all in one smooth uninterrupted operation. Rate of installation for the light metal line was about three miles per hour.

The pipe was mounted on a specially built trailer coupled to a plow having a hollow, curved blade. To start the operation, a short length of ditch was dug and the pipe fed into it and anchored securely. The tractor then moved off, depositing the pipe on bottom of the ditch.

When the pipe was uncovered and inspected following the test, it was found to be in good condition. At the present time, the length of lines without joints is limited to one mile. —**The End**

J. H. Williams

R. D. Sheehan

M. S. Williams

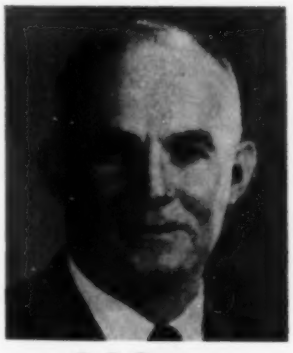
Felix Johnson

R. A. Gump

H. A. Roberts

O. R. Burden

Jack S. Gray



R. P. Gregory

T. A. Hester

E. G. Morrison

J. P. Neill

H. C. Price

R. B. Somerville

The Pipe Line Contractors Association will hold its twelfth Annual Convention at the Ambassador Hotel, Los Angeles, January 31 through February 3.

Officers and directors of the association are John H. Williams, Williams Bros. Co., president; R. D. Sheehan, Sheehan Pipe Line Construction Co., first vice president; M. S. Williams, Panama-Williams Corp., second vice president; Felix Johnson, Trojan Constructors Inc., treasurer; Richard A. Gump, executive secretary, and Hailey A. Roberts, assistant to executive secretary.

Other directors include O. R. Burden, O. R. Burden Construction Corp.; Jack S. Gray, Grayco Constructors Inc.; R. P. Gregory, Houston Contracting Co.; T. A. Hester, Oklahoma Contracting Co.; E. G. Morrison, Western Pipe Line Co., Inc.; J. P. Neill, J. P. Neill and Co., Inc.; H. C. Price, H. C. Price Co., and R. B. Somerville, Somerville Construction Co.

SATURDAY, JANUARY 30

6 p.m.—President's Party, Cocktails, Regency Room, Dinner, Colonial Room

SUNDAY, JANUARY 31

2 p.m.—Board of Director's Meeting.
5:30 p.m.—Reception, Big Three Welding Equipment Co., Houston.
7 p.m.—Dinner Dance—H&L Tooth Co., Montebello, Calif., Cocoanut Grove

MONDAY, FEBRUARY 1

7:30 a.m.—Early Birds Breakfast, Insley Manufacturing Corp., Indianapolis, Venetian Room
10 a.m.—General Business Meeting
12 noon—Ladies Luncheon, Allis-Chalmers Manufacturing Corp., Milwaukee; Men's Luncheon, M. J. Crose Manufacturing Co., Tulsa.
2 p.m.—Gin Rummy Tournament, Polyken Sales Division, The Kendall Co., Chicago, Grove Lounge
6 p.m.—Cocktails and Dinner, Caterpillar Tractor Co., Peoria, Ill.

TUESDAY, FEBRUARY 2

7:30 a.m.—Breakfast, Louisiana Machinery Co., Monroe, La., Venetian Room
10 a.m.—General Business Meeting
11:30 a.m.—Election of Officers
12 noon—Luncheon and Show, Crutcher-Rolfs-Cummings, Inc., Houston, Cocoanut Grove
2 p.m.—Gin Rummy Tournament, Polyken, Grove Lounge
6 p.m.—Cocktails, International Harvester Co., Melrose Park, Ill., and Superior Equipment Co., Bucyrus, Ohio
7:30 p.m.—Banquet and Floor Show, Cocoanut Grove

WEDNESDAY, FEBRUARY 3

8 a.m.—Meeting of New Board of Directors, Frenchette Room
9:30 a.m. Labor Meeting.
12 noon—Adjournment

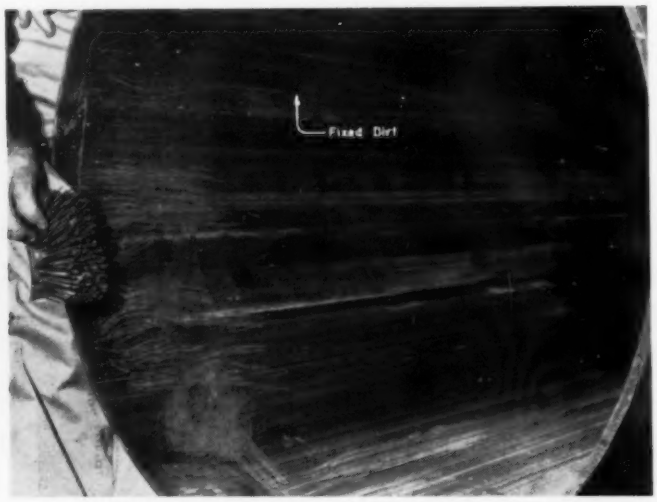


FIGURE 1—Do stiff steel brushes affect the coating? The answer is obvious. Notice the coating curled up on the ends of the bristles. Only 40 pounds pressure was applied to this brush.

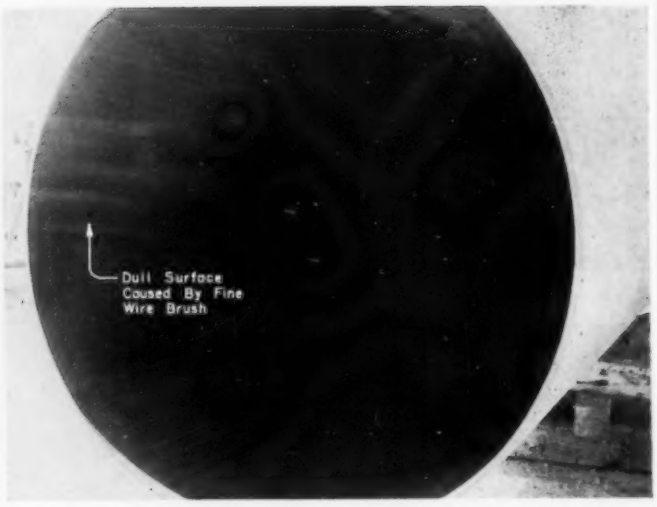


FIGURE 2—Damage by very soft steel brushes on a pig. This may be sufficient to cause drop in flow efficiency states the author.

Cleaning Internally Coated Lines After Construction and Testing

The popular new internal coatings can be scratched—and this can diminish flow efficiency. The solution? Run flotation agent ahead of cleaners to carry out dirt, etc.

By Clinton McClure
El Paso Natural Gas Company
El Paso, Texas

MANY GAS companies are making plans to coat their lines internally, and this brings up the subject of cleaning the internally coated pipe. How much damage does conventional cleaning do? How will this affect the efficiency of the line?

These and similar questions are making the subject of line cleaning very popular at this time.

Cleaning in the Past. The economics of maintaining a properly cleaned pipe line have never been thoroughly investigated. Dirty lines are not always recognized—so long as no dirt will blow out the open end of the pipe line, many in our profession have regarded it as being clean, and presumably operating at its maximum efficiency.

In the past most pipeliners had their own pet ideas on how to clean new pipe. Most of them placed utmost faith in a particular style pig—usually the one with *"mostest"* and the meanest-looking blades and brushes. Once this ferocious looking pig had traversed the pipe, it simply had to be clean so far as they were concerned.

New Line Cleaning. After a new pipe line goes in service there is only a 50-50 chance that it will be checked for efficiency. If it is checked, there is another 50-50 chance that the new pipe line was slightly loaded, and the efficiency may appear to be 2 percent higher than that of most new pipe.

After flow formula investigation and improvement, we began to notice a 2 percent loss below that of new pipe; and, indeed, we felt fortunate if we could get within 2 percent of mill pipe efficiency.

About this time epoxy resin coatings were being developed as an internal coating. These new coatings were found to decrease the wall roughness of mill pipe. Investigations showed that unweathered mill pipe had an average relative roughness of 750 micro-inches. After coating with epoxy base resins, this could be reduced to 250 micro-inches or lower. According to calculations, this meant that up to 6 percent efficiency could be obtained by coating mill pipe.

Several pipe lines were coated with various brands of epoxy base resins and subsequent tests proved that up to a 6 percent increase in efficiency could be gained by internal coating. (See PIPE LINE INDUSTRY, July 1959, pages 36 to 45.)

As a result, the natural gas industry is now spending millions of dollars to apply internal coating by different methods and to varying thicknesses.

Evaluation of Cleaning Methods. Cleaning the mirror-like finish of the epoxy resin coating has not been

FIGURE 3—Dust and rain spots in coated pipe after traveling 350 miles by truck to the test site. This is sufficient to cause scratching.

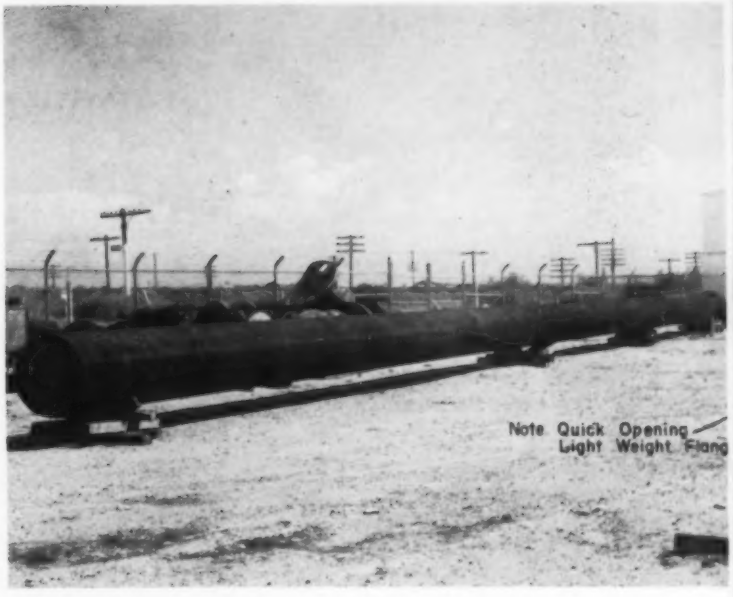


FIGURE 4—Three joints of internally coated pipe were welded up to form a test run.

FIGURE 5—Squeegee pig was modified to permit gas to blow past the pig on the theory that it would carry dust, etc., ahead of the pig and eliminate scratching.

FIGURE 6—How the pig in Figure 5 worked out. Note the fine scratches.

thoroughly investigated by the gas industry. If we could get the shiny pipe into the ground without getting it dirty, there wouldn't be any problem. But many companies coated the pipe, stored it on racks for a year and then put it in service. It was thought that as much as one-half of the total gain of efficiency could be lost by the time the pipe got into service because of dust, dirt, grime and improper cleaning. This brought up the problem of cleaning. Yet, it was discovered that conventional stiff wire brush pigs could sometimes peel the coating from the surface. Figure 1 shows the effect of a conventional steel wire pig brush on the coating. Note the curls of paint in the bristles. In this instance, the force on the brush did not exceed 40 pounds.

The softest steel wire brush available was tried by hand with results shown in Figure 2. The soft wire brush also buffed the smooth surface. It could be seen that wire brushes would damage the coating. Coating manufacturers were consulted and they reported hardnesses from 3H to 6H pencil lead was what could be expected.

Test Program. Several joints of coated pipe (2 mil thickness) were trucked to a central point for cleaning tests. Figure 3 shows the general

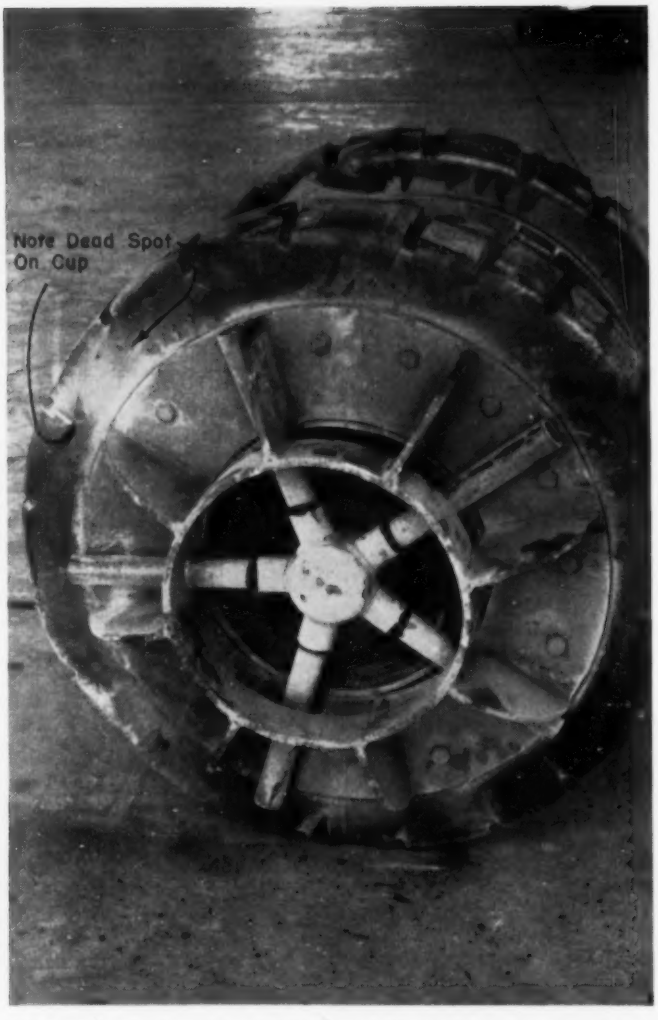


FIGURE 7—Another modified pig. The results were similar to those obtained with the first squeegee.

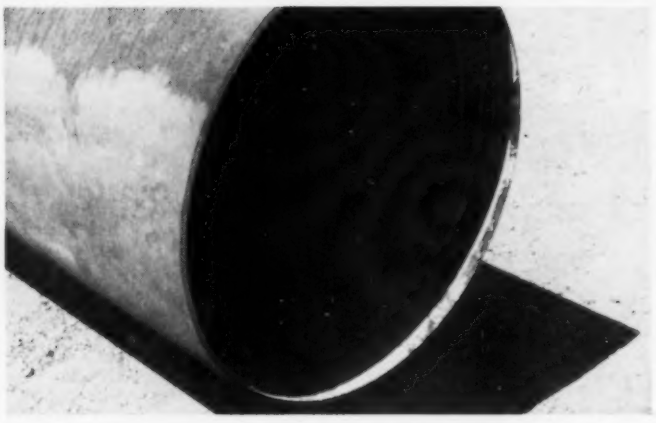


FIGURE 8—A second test run of coated pipe was so clean it had to be artificially dirtied up. Mud and water were blown through it.

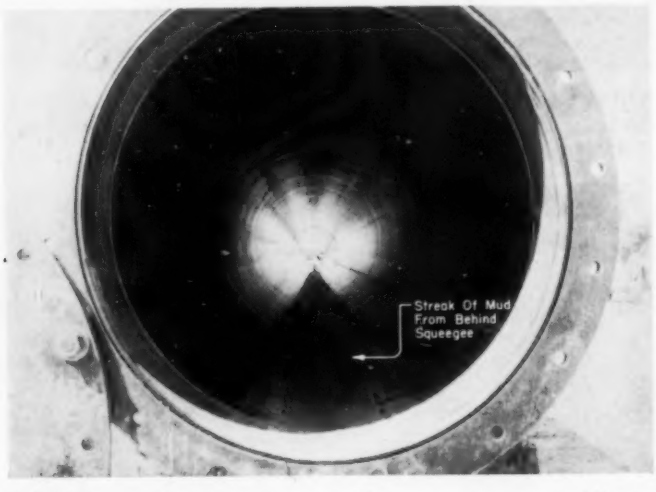


FIGURE 9—Dishwater detergent in water was run with the pipe elevated at an angle of 30 degrees. Note how thoroughly the pipe was cleaned. From this test it was concluded that the best cleaning would depend on removing dirt, etc., from the line ahead of the pig.

appearances of the surface of the coating prior to commencing tests.

The joints were welded together for testing (Figure 4). Assuming a steel brush pig could not be used, a squeegee was modified as shown in Figure 5. The rubber cups were notched to allow gas to pass next to the pipe wall to sweep the abrasive dirt ahead of the pig. Figure 6 shows the effect of that run. The surface was being handled so gently that fixed dirt was not being loosened. Flute equipped pigs such as shown in Figure 7 were used with the same results. Each run would produce additional scratches.

How About Oil Inside the Pipe? Information was needed pertaining to adhesion of pipe line oils and fluids to the coating. The interior was sprayed with pipe line fluids and the joint was then pigged six times. These fluids were as difficult to remove as on uncoated pipe. It was interesting to note that the fluids covered all scratches caused by pigging. The fingernail test proved the scratches still existed but could not be seen. The three joints were then steam cleaned and sent back to the rack.

Additional Test. Another three joints coated with a different brand epoxy resin were shipped to the test point. These joints were too clean to conduct a cleaning test on. Ten gallons of right-of-way dust was fogged into the test joints. Mud was made from the dust and applied to the coating as shown in Figure 8.

A two-cup squeegee was inserted in one end of the test pipe. The pipe was filled with a water column 20 feet long. Detergent of the dishwashing type was added to the water. In order to hold the water in a column in the pipe, the pipe was elevated to a 30° angle; and motive gas was applied behind the squeegee. It traveled through the pipe in 20 seconds pushing the water and detergent ahead of it. Because the run was short, very little agitation was obtained. Figure 9 shows the appearance of the pipe after this run.

The photos do not clearly show it, but the expander rings in the pipe could be easily seen for the first time since the coating was applied. The detergent produced a sheen on the coating that clear water alone could not produce. Mud stains could be seen on the coating but they produced no physical roughness.

In conclusion, it appears that a floating agent is necessary to remove

Continued on Page 54

Designing Pipe Line Crossings of Railroads and Highways

Here are three methods: the API revised Code 1102, the American Railway Engineers Association and the Design Criteria of the American Society of Civil Engineers

By Ernest A. Slade, President
Okan Pipeline Company
Tulsa, Oklahoma

BURIED PIPES derive their ability to support the vertical loads to which they are subjected from the inherent strength of the pipe and from lateral earth pressures acting against the sides of the pipe.

In the case of rigid pipes, the outward movement of the sides of the circular ring under the influence of vertical loads is negligible, and the only lateral pressure which can be relied upon to augment its load-carrying capacity is the active lateral pressure of the soil.

With flexible pipes the situation is very much different. As these flexible rings deform under load the sides move outward against the soil a sufficient distance to develop a substantial amount of the passive resistance pressure of the soil. These pressures greatly increase the load-carrying capacity of this flexible type of structure and account for the fact that *thin light weight pipes, when properly installed, are capable of supporting the heavy loads produced by relatively high embankments.*

THE REVISED API CODE 1102

The deflection of a loaded circular pipe can be determined by the theory of elasticity applied to thin rings. In general, a flexible metal pipe under an embankment load deforms as shown in Figures 1 and 2.

The loads acting on a flexible pipe under an embankment may be assumed to be as follows:

1. The vertical load is determined by Marston's theory of loads on conduits, and is distributed approximately uniformly over the width of the pipe. The transmitted load of moving traffic is computed by the Boussinesq theory and is additive to the earth load.

2. The vertical reaction on the bottom of the pipe is equal to the vertical load and is distributed uniformly over the bedding of the pipe.

3. The passive horizontal pressures on the sides of the pipe are distributed parabolically over the middle 100 degrees of the pipe and the maximum unit pressure is equal to the modulus of passive pressure of the side fill soil multiplied by one-half of the horizontal deflection of the pipe. This loading is shown in Figure 3.

Deflection. With the load hypothesis established, it is possible to develop a mathematical expression for the horizontal deflection of a flexible pipe in terms of the load, the properties of the pipe, and the properties of the soil at the side of the pipe. This expression is:

$$\Delta X = \frac{K W_c r^3}{EI + 0.061 e r^4} \qquad (1)$$

Where:

ΔX = immediate horizontal deflection of pipe, in.
W_c = vertical load on pipe, pounds for lineal inch
r = radius pipe, in.
E = modulus of elasticity of pipe metal, psi
I = moment of inertia of cross section of pipe wall, in.^{4} per in., or $\frac{t^3}{12}$
e = modulus of passive resistance of side fill soil, psi per in.
K = a parameter dependent upon the bedding angle (for 60° angle $K = 0.09$)

In this equation, the deflection under load is equal to the load parameters divided by the sum of the stiffness factor of the pipe and the support to the pipe developed through the passive resistance pressure of the soil.

Observations of deflections in culverts were compared with those calculated using the above equation, and in the 15 cases investigated, the coincidence between the measured and calculated deflections in all cases was very close. These measurements also indicated that the horizontal and vertical deflections were essentially the same.

Flexible pipes continue to deflect slowly for a long time after installation and application of the maximum load has been reached. This has been called "deferred deflection" and is similar to the settling of a foundation in soil long after a structure is completed and fully loaded. A conservative value of deflection lag has been chosen as 1.25 to 1.5 times the immediate deflection. The use of this factor results in an equation for determination of conduit deflection due to imposed vertical loading.

$$\Delta X_1 = \frac{D_e K W_c r^3}{EI + 0.061 e r^4} \qquad (2)$$

Where:

ΔX_1 = ultimate long time deflection of the pipe
D_e = the deflection lag factor

$$\Delta X_1 = \Delta X D_e \qquad (3)$$

Determining casing thickness. The method for determination of loads uses Newmark's integration of the

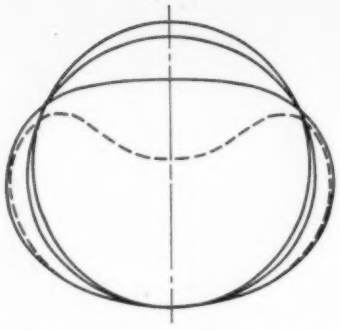


FIGURE 1—Stages of deflection of a flexible culvert. Lateral pressure of soil resists lateral expansion.

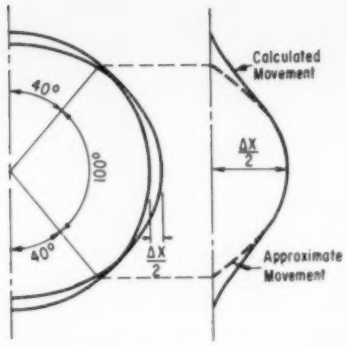


FIGURE 2—The horizontal movement of the sides of a circular ring when it is deformed into an ellipse, which is generally the pattern for deformation of a flexible ring.

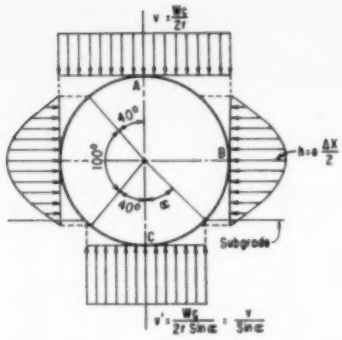


FIGURE 3—Distribution of pressures around a flexible pipe under an earth fill.

Boussinesq equation and is familiar to all those acquainted with the mechanics of soils.

By substituting the value of $I = \frac{t^3}{12}$ in the equation (2), we develop an expression for the wall thickness in terms of a specified deflection, the vertical loads, and the properties of the pipe and soil as follows:

$$t = E^{-1/3}\left[\frac{12\,K\,W_c\,r^3}{\Delta X} - 0.732 e r^4\right]^{1/3} \qquad (4)$$

This equation reduces to:

$$t = 0.04325\ B_d\ \sqrt[3]{B_d\,(C_d\,B_d + 64.478\,I_c - 11.711)} \qquad (5)$$

Where:

B_d = width of ditch or bored hole, feet
C_d = function of ratio of H/B_d coefficient of internal friction of the soil above the pipe—Figure 7a
t = wall thickness of casing, inches
H = fill height, feet
I_c = Influence coefficient for loads transmitted through soil—Figure 7b

and for a Cooper's E-70 load with 75 percent impact:

$$\Delta X_1 = \frac{0.1281\ B_d^4\ (C_d\,B_d + 66.90\,I_c)}{1054\ t^3 + B_d^4} \qquad (6)$$

and

$$S = \frac{51.74\,B_d^2}{t^2}\,(C_d\,B_d + 66.90\,I_c - 6.929\,\Delta X_1) \qquad (7)$$

Where:

S = stress in casing, psi

(Equations (5), (6) and (7) are those used in API Code 1102, Third Edition, May 1957.)

Values of casing thickness in inches versus casing diameters in inches for various depths of cover in feet below base of rail under Cooper's E-70 load (assumed to be the total locomotive load of 497,000 pounds evenly distributed over an area of 8 feet by the 52-foot length of locomotive) plus 75 percent impact for three types of soil are shown in Figure 4 and the deflections of casings under railroads with E-70 load plus 75 percent impact 4.0 feet below base of ties is shown in Figure 5. The 30,000 psi limiting stress was imposed to allay the fears of designers who could not completely accept the fact that flexible conduits fail by excessive deflection rather than stress. The maximum allowable deflection is limited to 5 percent in API Code 1102.

A comparative tabulation of casing wall thickness is shown in Table 1.

THE AMERICAN RAILWAY ENGINEERING ASSOCIATION METHOD

The values of thickness used by AREA in its specifications are reputed to be based on values computed by use of Talbot's formula for rigid structures:

$$M = \frac{1}{16}\,(1 - q)\ W_d$$

Where:

M = maximum moment
q = ratio of horizontal to vertical pressure, 0.37
W = total vertical load per foot
d = diameter

and

$$fs = \frac{M}{\text{Sec. Modulus}}$$

fs = 18,000 psi

TABLE 1—COMPARISON OF SPECIFICATIONS FOR RAILROAD PIPE CASING

Outside Dia.	A.P.I.[1]	A.R.E.A.[2]	National Pipe		ASCE	Highway 2% Cover
Ins.	t	t	t_1	t_2	t	t
6⅝	.188	.250	.188	.188	.188	.188
8⅝	.188	.250	.188	.188	.188	.188
10¾	.188	.250	.188	.188	.188	.188
12¾	.188	.250	.219	.219	.188	.188
14	.188	.250	.250	.250	.188	.188
16	.188	.250	.250	.250	.188	.219
18	.250	.3125	.250	.250	.188	.219
20	.250	.3125	.250	.250	.188	.219
22	.250	.375	.312	.312	.219	.219
24	.281	.375	.312	.312	.219	.250
26	.281	.437	.312	.312	.250	.312
28	.312	.437	.344	.344	.250	.312
30	.312	.500	.500	.375	.250	.375
32	.312	.500	.500	.375	.312	.438
34	.312	.500	.500	.406	.312	.500
36	.344	.5625	.500	.406	.344	.563
38	.344	.5625	.500	.406	.375	.563
40	.344	.625	....	.438	.438	.625
42	....	.625	....	.438	.500	.625
48	.344	.....	....	.438	.625	....

1 Based on 30,000 p.s.i. max. fiber stress.
2 Based on 35,000 p.s.i. max. fiber stress.
t_1 —Wall thickness based on Deflection load to allow ½" clearance.
t_2 —Wall thickness based on Load to deflect pipe 3% O.D.
t =Wall thickness.

AREA recommended thicknesses could not be determined by use of these equations.

The wide differences in wall thickness required by AREA and that recommended by API Code 1102 leave much middle ground to be explored to determine the proper values to be used. Practically all railroads now follow the AREA recommendations in their requirements for casing before crossing permits will be issued. This often results in much needless waste of steel and increases the cost of crossing installations greatly over that required by use of the flexible conduit or Iowa formula as shown in API Code 1102 and now being used by the ASCE Committee for Design Criteria.

DESIGN CRITERIA OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

The design criteria are based on the Iowa design method and concept of thin-ring elastic analysis. This method involves the use of empirical values of the moduli of passive resistance of the soil media around the pipe and limitations with respect to strains in the pipe wall. Conservative values for average soil conditions have been used in the specification pending development of more factual data on the passive moduli for various types of soils. The pipe line division of ASCE has established a research program to obtain data on the passive moduli of representative soils in various sections of the country.

The design criteria contains external loading data, design formulae and minimum strength factors to be used in designing casings and continuous pipe lines installed by trenching or boring methods under railroads and highways.

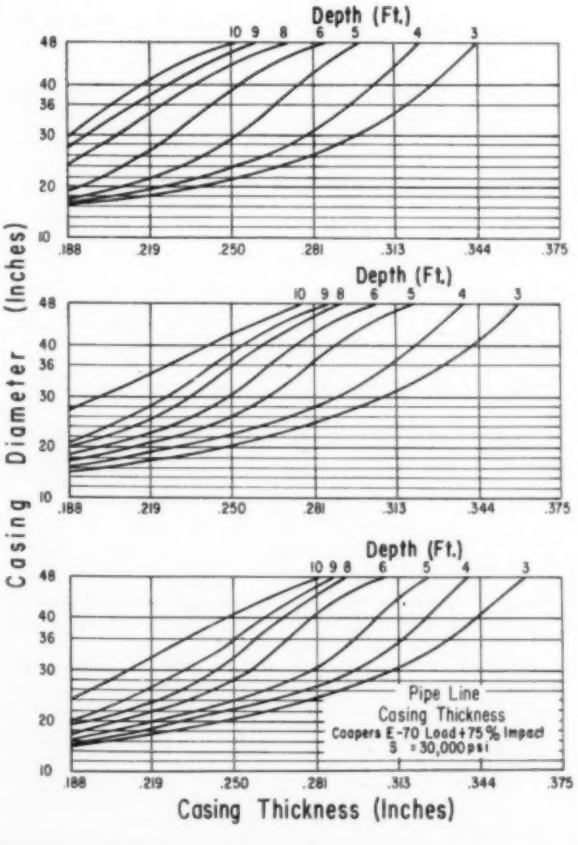


FIGURE 4—Pipe line casing thickness vs. diameter at varying fill heights and in three types of soil. Top, granular soil; middle, ordinary clay; bottom, saturated clay.

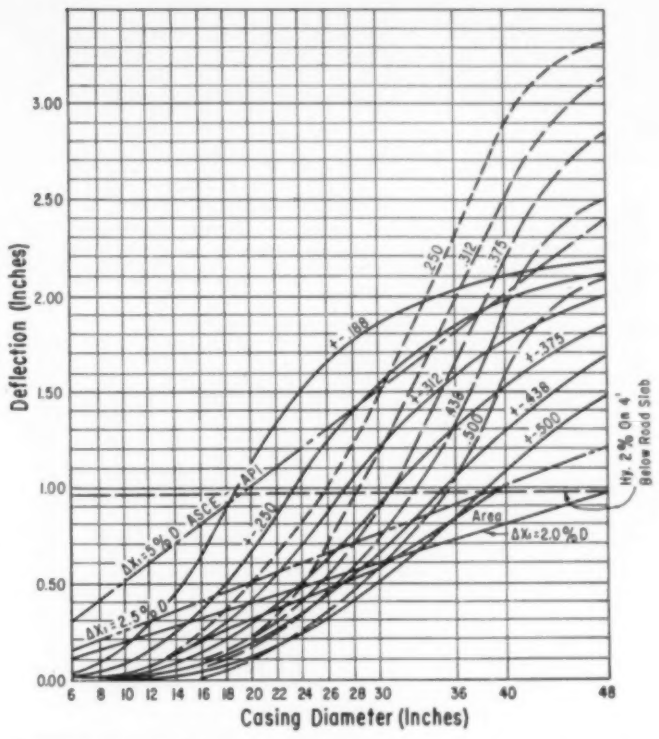


FIGURE 5—Deflection in pipe line casings for various diameters and wall thicknesses for crossings under railroad tracks. Solid lines are API Code 1102 and dashed lines are ASCE values for corresponding wall thicknesses.

The loads are essentially as follows:

Highways

1. Overburden dead load 120 pounds per cubic foot.
2. Live loads, impact factors and infrequent overloads shall conform to the design criteria used by the agency having jurisdiction. In the absence of such criteria the following minimums shall apply:

Type of Loading	MINIMUM LOAD IN POUNDS—TYPE OF ROAD	
	Heavy Duty	Light Duty
Tandem Axle	48,000	32,000
Single Axle	27,000	18,000
Single Wheel	15,000	10,000

Impact factors of 1.0 shall be used for rigid pavements and 1.5 for flexible pavements.

Railroads

1. Dead load including earth ballast and ties computed from base of rail unless actually determined shall be 120 pounds per cubic foot.
2. Live load for main line railroads (Cooper's E-72) shall consist of 4 axles of 72,000 pounds each on 5-foot centers distributed uniformly over an area 20 feet by 8 feet at base of ties. Track load of 200 pounds per lineal foot of track shall be distributed with locomotive load.
3. Branch line loads to be specified by railroad companies with use of 200 pound track load.
4. Impact load of 75 percent of live load is added for depths of casing to 5 feet below base of ties and shall

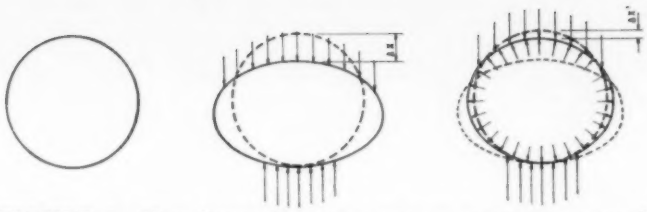


FIGURE 6—How internal pressure acts to overcome external loads. Left, no external load, no internal pressure; center, external load only; right, external load plus internal pressure.

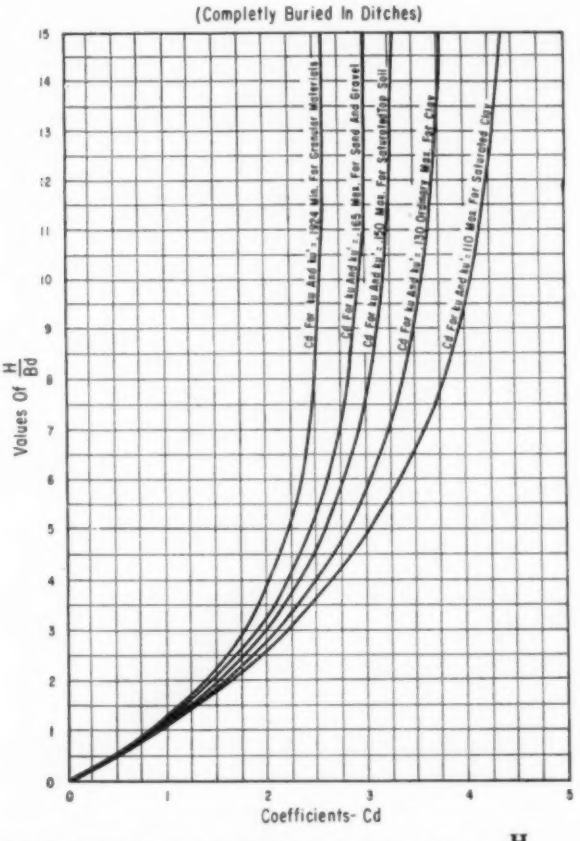

(Completly Buried In Ditches)
Values Of H/Bd
Coefficients- Cd
Cd For ku And ku' = .1924 Min. For Granular Materials
Cd For ku And ku' = .165 Min. For Sand And Gravel
Cd For ku And ku' = .150 Min. For Saturated Top Soil
Cd For ku And ku' = .130 Ordinary Min. For Clay
Cd For ku And ku' = .110 Min. For Saturated Clay

FIGURE 7a—Values of coefficient C_d plotted against $\frac{H}{B_d}$.

The load per unit length, $W_c = C_d W B_d^2$ (foot pound units)

W = unit weight of fill materials

B_d = Breadth of ditch at the top of conduit

H = Height of fill over top of conduit.

decrease at uniform rate of 3 percent of depth beyond 5 feet to a value of zero impact at 30 feet depth.

External Loads

Calculations are to be based on Marston's theory of external loads on conduits by use of Boussinesq theory of stress distribution in soils. This method is applicable to bored or jacked installations where the bored hole is essentially the same size as the O.D. of the pipe and its protective coating, or if the hole is bored larger the void space between the pipe and soil shall be grouted to provide firm contact between pipe and soil.

Definitions of Symbols

The following are definitions of symbols used in the formulae for calculating the external loads on conduits and piping from dead and live load applications:

W_d = Dead loads in pounds per linear inch of pipe line

B_d = Width of trench in feet

For trenching installations, use the actual width of trench. B_d shall be taken as the actual width of the trench at the elevation of the top of pipe. Load equation (8) is not applicable if the trench width exceeds 2 to 3 times the outside diameter of the pipe. For bored installations, the width shall be the diameter of the bored hole.

w = Unit weight of actual fill material in pounds per cubic foot.

H = is the height of cover above top of casing in feet.

C_d = the coefficient of the dead load imposed on the conduit. For values of this coefficient, see Figure 7a.

W_t = the load on the conduit, due to highway live loads in pounds per linear inch of conduit.

P = the truck wheel load in pounds.

F = the impact factor

L = the segmental length of the casing in feet. A value of 3 ft. for L is used in formula (9).

C_t = the coefficient of the highway live loads on the conduit based on Newmark's integration of the Boussinesq equation.

W_r = the live loads on the conduit due to railroad live loads in pounds per linear inch of conduit.

P_r = the uniform load due to locomotive loading, including impact and track weight, pounds per square foot.

D = the outside diameter of the pipe in inches.

C_r = the coefficient of the track and railroad live loads on the conduit based on the Marston-Spangler method used in Newmark's integration of the Boussinesq equation.

Formulas of Loadings

Dead Load—the formula for calculating the dead load shall be as follows:

$$W_d = \frac{C_d \; w \; (B_d)^2}{12} \qquad (8)$$

Live Load—Highway—the formula for calculating the highway live load shall be as follows:

$$W_t = \frac{C_t \; PF}{12L} \text{ or } \frac{C_t \; PF}{36} \qquad (9)$$

Live Load—Railroad—the formula for calculating the live load from railroad locomotive loadings shall be as follows:

$$W_r = \frac{4 \; C_r \; P_r \; D}{12 \times 12} \text{ or } \frac{C_r \; P_r \; D}{36} \qquad (10)$$

Deflection and Stress Calculations

Definition of Symbols—The following are definitions of symbols used in the formulae for calculating the deflections and stresses in the piping conduits:

ΔX_1 = the maximum horizontal deflection of pipe in inches.

J = the deflection lag factor (1.5 used in formula).

K = the bedding factor parameter, a function of the total bedding angle at 120° having a value of 0.09.

W_c = sum of the vertical dead and live loads on a pipe in pounds per linear inch of pipe.
For highway loads: $W_c = W_d + W_t$
For railroad loads: $W_c = W_d + W_r$

E = Modulus of elasticity of the pipe material in pounds per square inch. (For steel use a value of 30 millions)

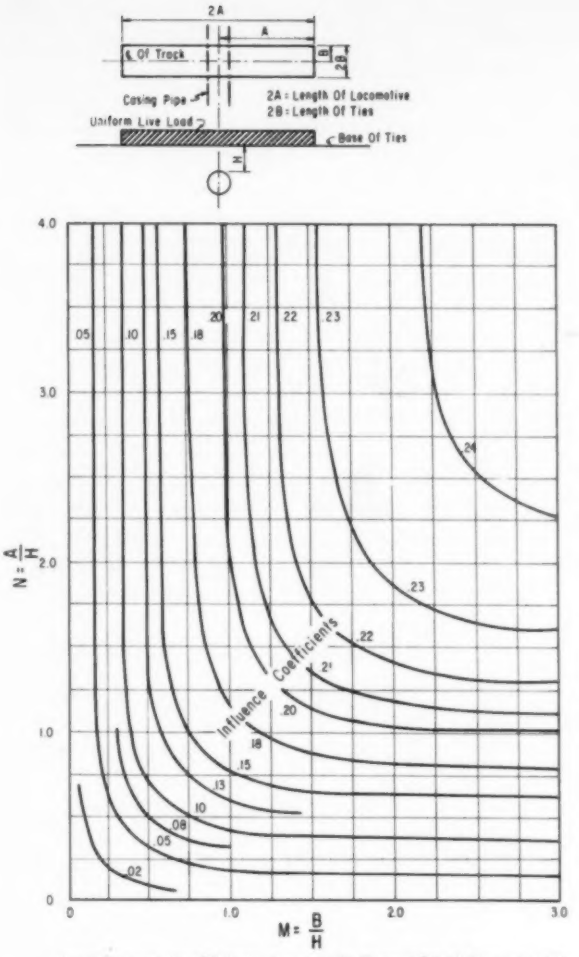
t = the nominal wall thickness of the pipe in inches.

I = the moment of inertia of a section of pipe wall—t inches in height and 1 inch long, in inches to the fourth power per inch of pipe length. $\frac{(t^3)}{(12)}$

e = the modulus of passive resistance of soil in pounds per square inch per inch of soil compression.

r = the mean radius of pipe in inches.

Z = the modulus of soil reaction in pounds per square inch or (er). Suggest value of Z for good soil 540 pounds/sq. in., for poor supporting soil, 270 pounds/sq. in.



Ic = Influence Coefficients For Loads Transmitted Through Soil

FIGURE 7b—Influence coefficients for loads transmitted through soil—I_c.

p = the internal fluid or gas pressure in pounds per square inch gauge.
D = the outside diameter of the pipe in inches.
f_d = the flexural ring tensile stress in the carrier pipe wall, due to external dead load, pounds per square inch.
f_v = flexural ring tensile stress in the carrier pipe wall, due to external live loads including impact, pounds per square inch.
f_p = circumferential tensile stress in the carrier pipe wall due to internal pressure in pounds per square inch.
$f_t = f_d + f_v + f_p$ = the total combined stress in the carrier pipe wall from external loads and internal pressure, pounds per square inch.

DESIGN FORMULAE FOR ASCE DEFLECTION AND STRESS CALCULATIONS

Deflection—The calculation of maximum horizontal deflection in casing (or carrier pipe uncased) not subjected to internal pressure shall be:

$$\Delta X_1 = \frac{1.62\ W_c\ r^3}{E\ t^3 + 0.72\ Z\ r^3} \qquad (11)$$

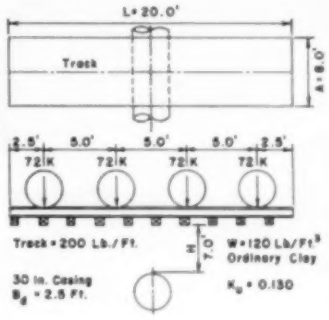
This equation is essentially the same as equations (2) and (6) noted above after terms have been combined and reduced to conform to units used in ASCE definitions of symbols—

Stress

The formula for calculations of wall stress of casing pipe without internal pressure is

EXAMPLE:

Determine wall thickness for 30 inch O.D. casing at a depth of 7.0 feet below base of ties under main line railroad with Coopers E-72 loading and casing installed in ordinary clay soil.



DEAD LOAD:

$$W_d = \frac{C_d\ w\ (B_d)^2}{12} \quad \text{(Eq. 8)}$$

$$\frac{H}{B_d} = \frac{7.0}{2.5} \qquad 2.800\ C_d = 1.99 \qquad \text{(Figure 7a)}$$

$$W_d = \frac{1.99 \times 120 \times 2.5^2}{12}$$

$$W_d = \frac{124.375 = 124.4}{\text{pounds/lineal inch}}$$

LIVE LOAD:

$$W_r = \frac{4\ C_r\ P_r\ D}{12 \times 12} \quad \text{(Eq. 10)}$$

Solve for C_r:

$$M = \frac{A}{2H} = \frac{8}{2 \times 7} = \frac{8}{14} = .5714 = .57$$

$$n = \frac{L}{2H} = \frac{20}{2 \times 7} \qquad \frac{20}{14} = 1.4286 = 1.43$$

C_r = 0.14264 (From Figure 7b or tabulation in ASCE Code)

$$W_r = \frac{4 \times 0.14264 \times 3067 \times 30}{12 \times 12} = 364.36 \text{ p.l.i.}$$

$W_c = W_d + W_r = 124.4 + 364.4 = 488.8$ p.l.i.

DEFLECTION: (Assume 0.25 inch wall thickness)

$$\Delta X_1 = \frac{1.62\ W_c\ r^3}{E\ t^3 + 0.72\ Z\ r^3} \quad \text{(Eq. 11)} =$$

$$\frac{1.62 \times 489 \times (15)^3}{30{,}000{,}000 \times .25^3 + 0.72 \times 540 \times (15)^3}$$

$$\Delta X_1 = \frac{2{,}610{,}000}{468{,}750 + 1{,}280{,}000} = 1.492 \text{ inches}$$

D = 30 inches

Allowable $\Delta X_1 = .05 \times 30 = 1.50$ inches

Therefore 0.250 inch wall casing is used.

American Railway Engineers Association Requires —.500 inch

API Code 1102 Recommends —.312 inch

Solve for P_r:

Impact = 1.00 + .75 — (H-5) .03
= 1.75 — (7-5) .03 = 1.69

$$\text{Locomotive} = \frac{1.69 \times 4 \times 72{,}000}{8 \times 20} = 3042$$

$$\text{Track} = \frac{20 \times 200}{8 \times 20} = 25$$

Pr = 3067 #/Sq. Ft.

$$f = f_d + f_v = \frac{1.24\ W_c\ r}{t^2}\left[\frac{1}{\dfrac{1\ \ 0.72\ Z\ r^3)}{Et^3}}\right] \text{ if } K_m = 0.138 \text{ and } J = 1.5 \qquad (12)$$

and for circumferential stress due to internal pressure

$$f_p = \frac{pD}{2t} \qquad (13)$$

and stress due to external loads and internal pressure in the pipe is

$$f_t = f_d + f_v + f_p = W_c\ \frac{1.4\ Etr}{Et^3 + 2.6\ p\ r^3} \qquad (14)$$

Where: $W_c = W_d + W_r$ or $W_d + W_t$

An investigation shall be made of the effect on stress intensity in the wall of the carrier pipe when the internal pressure may be reduced to zero while the uncased carrier is subjected to external loadings.

CONSENSUS DESIGN LIMITATIONS

A comparison of the design stress limitations of the four major bodies involved in the design of pipe line crossings under railways and highways is shown in Table 2.

Steel Pipe as a Carrier Within a Casing. The maximum allowable stress in a flexible steel carrier pipe due to internal pressure shall not exceed the percentage of the specified minimum yield strength of the pipe materials as defined in the ASA Specification B31 Section 4 for oil pipe lines and Section 8 for gas pipe lines as shown in Table 2—tabulation of design limitations.

TABLE 2—DESIGN LIMITATIONS

(Maximum allowable stress shall not exceed the tabulated percentage of the specific minimum yield strength of the pipe material as defined in ASA B31, Section 4 for Oil Pipe Lines and Section 8 for Gas Pipe Line.)

LOCATION	*AGA Percent	API Percent	AREA Percent	HIGHWAYS Percent
Case II Stress due to internal pressure in steel carrier pipe in casing under				
Highways				
1. Oil Lines	72	72	..	Safety Codes and Orders for pipes and pressure vessels at the Site.
2. Gas Lines ASA Class 4 Location	40	40	..	
3. Gas Lines ASA Class 3 Location	50	50	..	
4. Gas Lines ASA Class 2 Location	60	60	..	
5. Gas Lines ASA Class 1 Location	60	72	..	
6. Liquefied Petroleum Products	72	72	..	
Railroads				
1. Oil Lines	72	72	65	...
2. Gas Lines	60	72	50	...
3. Liquefied Petroleum Products	72	72	50	...
Case II Combined stress due to internal pressure and external loads in steel carrier pipe without casing under				
Highways				
1. Oil Lines	65	65	..	...
2. Gas Lines ASA Class 4 Location	40	40	..	...
3. Gas Lines ASA Class 3 Location	50	50	..	...
4. Gas Lines ASA Class 2 Location	60	60	..	...
5. Gas Lines ASA Class 1 Location	60	65	..	...
6. Non-flammable non-corrosive liquids or gases	..	..	..	60*
7. Corrosive or flammable liquids except liquid petroleum	..	..	..	40*
8. Corrosive or flammable gases at pressures less than 100 psi	..	..	..	30*
9. Corrosive or flammable gases at pressures over 100 psi and for liquid petroleum	..	..	..	20*
Railroads				
1. Oil Lines	65	65	50	...
2. Gas Lines—Railroad Main Lines	40	54	40	...
3. Gas Lines—Railroad Branch Lines	60	65	50	...
4. Liquefied hydrocarbons, and other by-products under main, branch and secondary railroads	65	65	20	...
5. Temporary installations on gas, liquefied hydrocarbons and other byproducts under minor branch lines and industrial spurs	60–65	65	1/40	...

* The above percentage of yield strength or 2/3 of ultimate strength of carrier pipe material, whichever is the lesser.

Flexible Casing Pipe—Case I. The following limitations shall be used in designing flexible casing pipe not subject to internal pressure:

a. The minimum wall thickness of pipe shall not be less than that required for handling and construction operations.

b. The maximum allowable vertical deflection of pipe shall be equal to 5 percent of the outside diameter of the pipe, but in no case shall the top of casing pipe be permitted to come in contact with the top of carrier pipe or spacers, nor under highways shall it exceed 2 percent of the depth of cover.

c. Where it is suspected that longitudinal sag in the casing pipe may occur, the pipe line company shall obtain and furnish, to the highway or railroad agency, sufficient subsoil data to allow an analysis of possible sag. Consideration shall be given to this sag by increasing the diameter of the pipe to make a satisfactory installation on all sizes of pipe having an outside diameter of sixteen inches (16 inches) and larger. No consideration of longitudinal sag shall be given to smaller sizes.

Flexible Carrier Pipe Without Casing—Case II. The total combined stress shall include the sum of the circumferential stress due to the maximum anticipated internal pressure plus the flexural ring stress due to the external loads. The maximum allowable stress in the carrier pipe shall be the percentage of the specified minimum yield strength of the carrier pipe material as defined in the American Standards Association Specification B31, Section 4 for oil pipe lines and Section 8 for gas pipe lines as shown in tabulation of design limitations.

Difficulties for Engineers. There is considerable confusion today in the design of railroad crossing casings. The present attitude toward the proposed ASCE specification taken by certain members of the AREA and highway groups is to follow a course of resistance to all change from the presently prescribed AREA specification, or failing that, to make the specifications so drastically limiting that its use would not be adopted by the industry. The research planned in this field will prove fruitless unless all groups concerned with the problem take an engineering approach to its solution.

—**The End**

About the Author

Ernest A. Slade, president of Okan Pipeline Company, started his pipe line career during World War II. He had charge of the design of a 750-mile pipe line which ran from Calcutta to Tinsukia, Assam, a 500-mile line from Chittagong to Tinsukia and others. He graduated from the Colorado School of Mines in 1934 with a B.S. degree in Petroleum Refining Engineering. His first job was with Parade Gasoline Co. where he designed and supervised construction of gasoline plants. Three years later he went with Hanlon-Waters as sales engineer, selling control devices for refineries, etc. After military service, he returned to his former company and in 1947 joined Stanolind Pipeline Company (Service Pipe Line Co.). He advanced to direct construction and maintenance of all of this company's lines at the time he resigned to become president of Okan.

Nitrous Oxide and Infrared Detector Supply Answer to Leak Problem

Pipeliners have fretted over the problem of finding leaks during hydrostatic tests for years. Here's one answer: Add N_2O to the test water, then run an infrared sniffer along the right-of-way. Even pinhole leaks will show up

By John E. Kaufman
Southwest Research Institute
San Antonio, Texas

IN RECENT RESEARCH, Southwest Research Institute has found a seemingly feasible means of detecting water leaks which show up in hydrostatic tests of pipe lines. In the past this has been a vexing problem to pipeliners on many occasions. (i.e. Finding a water leak in a pipe line buried some 30-inches in wet weather presents difficulties.)

The principle involved in this new technique is basically simple: if a gas is released in the loose back fill it will rise to the surface of the ground. If a readily detectable gas is included in the test water, it can be pinpointed in the vicinity of the leak.

Nitrous oxide appears to be best suited for this purpose. If it is blended into the test water under pressure, it will remain in solution until the pressure is released as it would be if the water escapes from the pipe. An infrared analyzer can detect concentrations of this gas as low as two parts per million. An adequate volume is 0.37 and to charge the water in 10 miles of 30-inch pipe line should require an expenditure of between $2,500 and $3,500. Of course, the water can be re-used, and this will reduce the cost.

This new technique is not perfected. Problems which must be resolved to make the system a finished commercial method are: establishment of the required test concentrations of N_2O; design of equipment and method for sampling air above the line, and a means of producing aqueous solutions of N_2O in the field in the required concentrations.

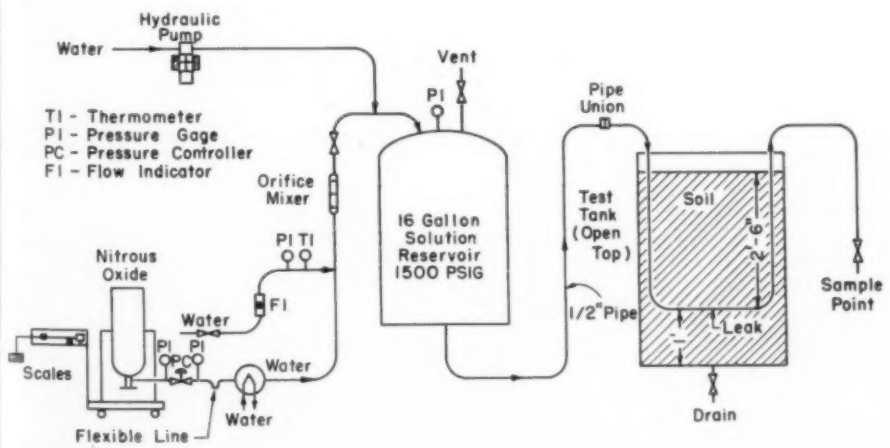


FIGURE 1—Schematic diagram of the test apparatus. Note that nitrous oxide and water are blended into reservoir under 1500 psig pressure. When this pressure is applied to the pipe line, if a leak exists the water and N_2O escape with the latter rising to the ground surface. An infrared analyzer can detect as little as two parts per million in atmosphere.

The testing of pipe lines is an essential part of their installation, upgrading and operation. Frequently, this testing is a difficult and time-consuming task. In addition it is also expensive. Pipe lines used for the transportation and distribution of gas must be free of leaks for economic and safety reasons. Hence, every gas pipe line must be tested for leaks prior to operation to conform to accepted codes. Wherever permissible, testing is done by means of gas pressure, and any leaking gas is detected by the various available techniques.

However, there are many situations in which hydrostatic methods are mandatory. One of these is in populated areas. Another is where applicable safety codes require it.

When a line is hydrostatically tested the presence of leaks is demonstrated by a drop in the line pressure. The location of individual leaks may be indicated by water shows. If a line under test is in an open ditch, leaking water can be easily seen in the bottom of the ditch. Many existing buried lines are tested and leaking water may, or may not, show at the surface of the ground. In some formations water leaking out of a pipe line will drain down into the ground and will never show above ground. In others, drainage may be lateral. In swampy areas leaking water will simply mix with the surrounding waters. **From the foregoing, it may be seen that hydrostatic testing has some serious limitations.**

A great deal of study has been devoted to finding leak detection methods by many interested parties. The American Gas Association retained Battelle Memorial Institute to study methods of detecting leaks in gas pipe lines during hydrostatic testing. In the final report[1] (July 31, 1958) on this work it was concluded that

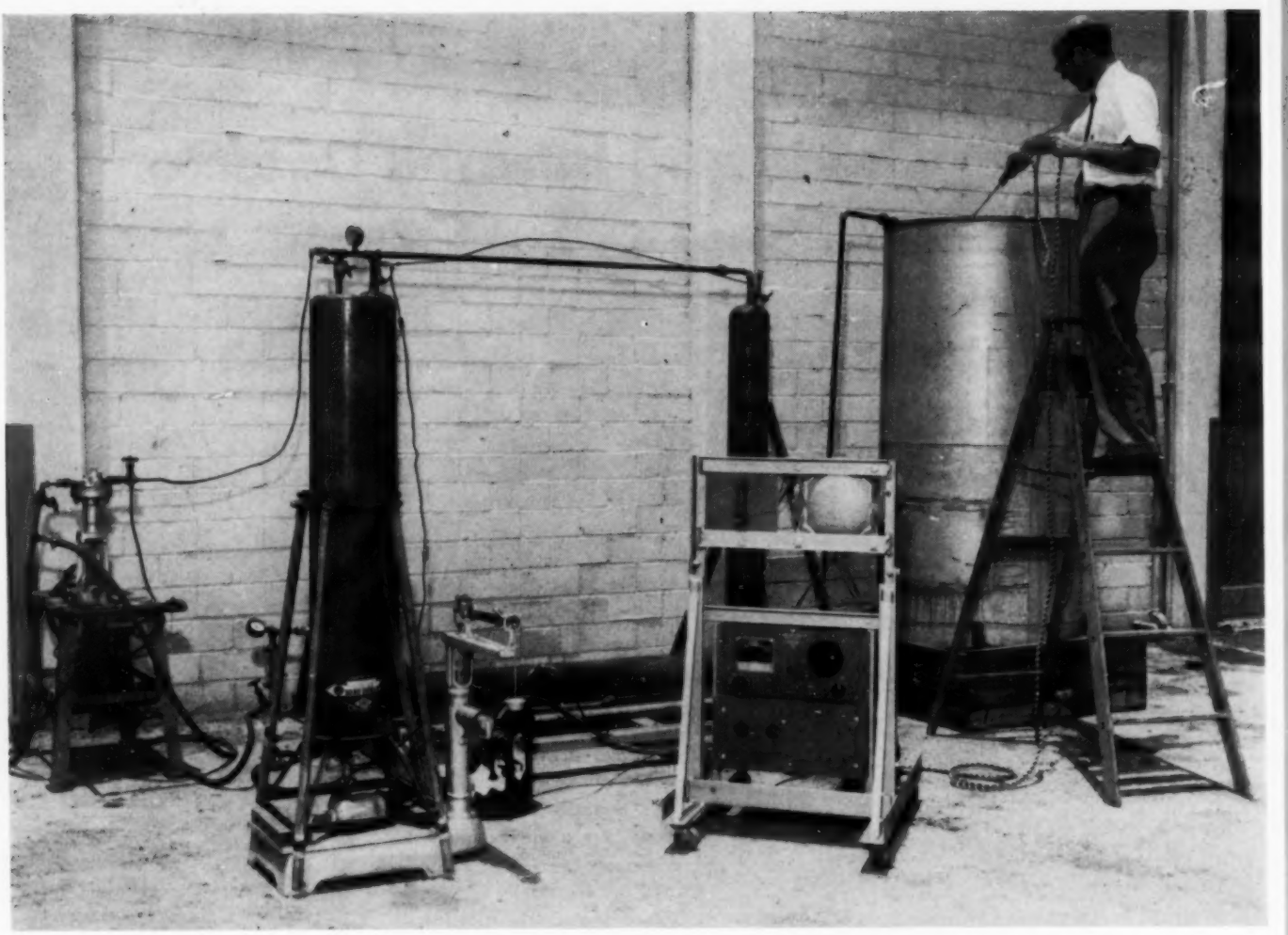


FIGURE 2—Photo of the test apparatus. Hydraulic pump at far left. Infrared analyzer is in right foreground.

the use of a gas tracer was the most feasible method for development, because of the commercial availability of highly sensitive gas detectors. Just such a method is the subject of this article.

Southwest Research Institute was engaged by Ohio Chemical & Surgical Equipment Company to carry out a series of preliminary laboratory tests to determine the feasibility of a nitrous oxide tracer gas technique for detecting leaks in pipe lines. Ohio Chemical & Surgical Equipment Co. has made application for a patent on the process which they will license.

Nitrous oxide is an ideal gas for leak testing, because it is non-toxic, non-corrosive, non-irritating, non-explosive and does not occur in nature. It is a man-made substance. Hence, it can not be detected, except where it has been deliberately liberated.

The objective of the work reported herein was to demonstrate whether the use of nitrous oxide as an aid to hydrostatic testing of underground pipe lines was sufficiently promising to warrant its development for commercial application. As will be seen from the ensuing data and discussion, its promise has been demonstrated and the areas needing development have been highlighted.

Experimental Work. The general procedure used to test the leak detection technique was to make up a water solution of nitrous oxide; force it through an artificial leak in a pipe buried under 2½ feet of soil in an open tank. While the nitrous oxide solution was being forced out of the pipe into the soil the surface was scanned with the detector probe until a positive show of nitrous oxide was detected.

Solutions of nitrous oxide were made up at atmospheric pressure by adding the liquid material at a uniform rate to a stream of water flowing at a rate of one gallon per min-

TABLE 1—Laboratory Test Results

Test No.	1	2	3	4	5
Nitrous Oxide Added, lb.	2.94	1.48	3.00	1.70	3.10
Water Added, gal.	16	16	16	16	16
Nitrous Oxide Concentration (Analytical) Vol gas/Vol water at atmospheric pressure	0.37	0.29	0.13	0.05±0.02	0.23
Test Pressure, psig	1500	1500	1500	1500	150-1500
Soil Condition[1]	Loose	Soaked	Packed	Packed and Soaked	Loose
Leak Rate, gal. per hour	8.4	8.4	8.4	8.4	2
Time to Detect Nitrous Oxide, minutes					
First Show	4	4	4½	15	5
General	5	5½	5½	20	...
Nitrous Oxide Detected, ppm	5-100	2-100	5-15	2	¾-2½
Nitrous Oxide Released, lb/hr at 70° F, 1 atm.	0.048	0.038	0.017	0.007	0.007

[1] All soil used was the normal, sticky, black variety available on the Southwest Research Institute grounds.

ite. Mixing of nitrous oxide and water was accomplished by passing the combined streams through an orifice mixer. Sufficient solution was made up to supply the leak for almost two hours at the test pressure of 1,500 psig.

The artificial leak was a hole drilled in a length of ½-inch pipe oriented so that the leaking material would enter the soil bed in a downward direction. The hole was made with a No. 80 drill, 0.0135-inch diameter. It allowed 8.4 gallons per hour to flow out of the pipe.

When the system was filled with solution a sample was taken in such a manner as to exclude air. Then a pressure of 1,500 psig was applied with a hydraulic pump, and the surface of the soil was repeatedly scanned with the detector probe until nitrous oxide was positively sensed.

Figure 1 is a schematic diagram of the test apparatus and Figure 2 is a photograph of the equipment. For convenience the solution reservoir was a U-shaped length of standard 6-inch pipe. This can be seen in the background of Figure 2. The detector used was a standard infrared analyzer. Samples of air from the surface of the soil were obtained by a vacuum-sniffer type probe at a rate of 20 cubic feet per hour.

Five laboratory tests and one field test were run. The results of the laboratory tests are in Table 1.

The field test was run in the same fashion as the laboratory tests, except that the test section was a 20-foot length of ½-inch pipe buried in a trench 1 foot wide, 3 feet deep and about 20 feet long. The pipe was buried in caliche typical of the San Antonio area. (This material is a dense, alkaline clay-type soil.) The leak was located about midway along the buried pipe and it was pointed down.

At 5 minutes after pressure was applied to the system 2 to 2½ parts nitrous oxide per million of air were detected at the surface. In four hours the concentration had increased to a range of 2 to 7½ parts per million in shallow surface indentations with the maximum concentrations detected closest to the leak. The observed test concentration was 0.1 volume gas/volume water. All traces of nitrous oxide in the test area had disappeared within 48 hours (see Figure 3).

Analytical procedure for determination of nitrous oxide in water by infrared absorption. A one-milliliter sample of the nitrous oxide solution was injected by syringe onto a fritted glass disc. Air then passed through the fritted disc into a 1-meter infrared cell of 950 milliliters volume which had been previously evacuated. The air swept the nitrous oxide from the water. The displaced gas was dried in an Ascarite scrubber as it passed to the infrared cell. Flow rate was controlled by a restriction in the line just ahead of the cell. About 1½ minutes were required for the cell to come to atmospheric pressure.

The infrared cell was calibrated by introducing known volumes of nitrous oxide and measuring the absorbance at approximately 4.47 microns. Minimum detectable amount of nitrous oxide was 0.01 milliliter of gas per milliliter of air at room temperature.

The procedure was checked by resweeping the same sample. It was found that 96 percent of the nitrous

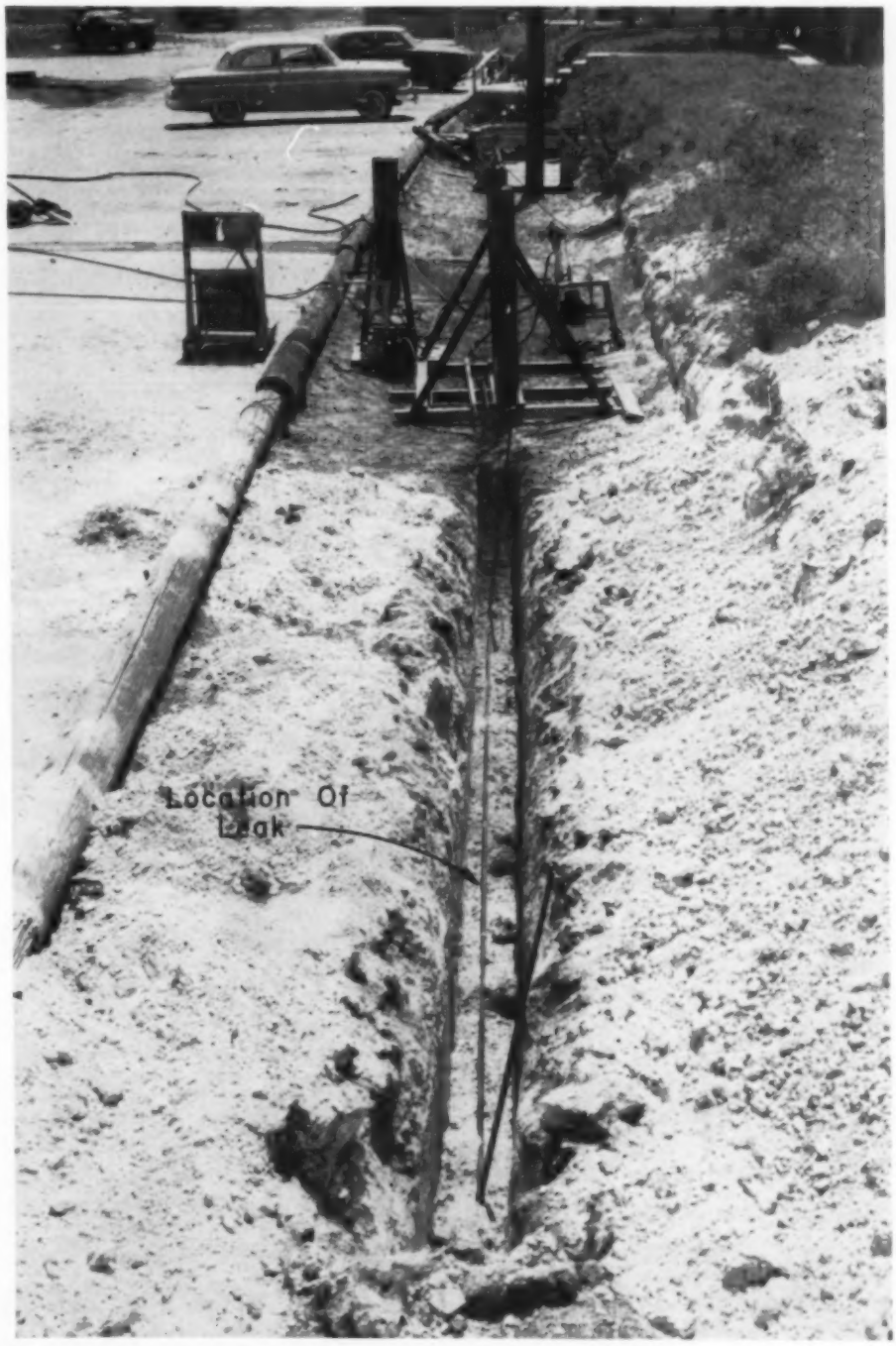


FIGURE 3—Field test set-up before filling trench. The leak is of pinhole size.

oxide originally present had been removed.

The objective of the work was to determine the feasibility of using nitrous oxide in solution as a tracer gas to find the existence and location of leaks in underground pipe lines. As may be seen from the results shown in Table 1 and from the field test, the feasibility of such a technique has been demonstrated. Concentrations of nitrous oxide as low as 0.05 volume of gas per volume of water produced detectable surface concentrations and leak rates as low as 2 gallons per hour were sufficient.

A common denominator for concentration of nitrous oxide used and leak rates is pounds of nitrous oxide released per unit time. Based upon the data obtained in the laboratory and field tests it is anticipated that as little as 0.007 pound per hour can be released and detected. In the test with the highest concentration, 0.048 pound per hour gave excellent response. The matter of what is a significant leak depends upon safety considerations and what is leaking. The economic magnitude of a leak, of course, depends upon the value of the materials lost through the leak. If the maximum permissible leak is set, a solution concentration of nitrous oxide could be used to release an amount between 0.007 and 0.048 pound of gas per hour.

Economics. Based upon a cost of nitrous oxide at 25 to 35 cents per pound, the cost of the gas for charging 10 miles of 30-inch pipe line with water containing sufficient gas to be detected from a leak of 8.4 gallons per hour would be $2,500 to $3,500, using 0.37 volume of gas per volume of water. It is possible, though, that this cost could be reduced to one-half or possibly one-quarter. However, if, as has been estimated, the cost of present hydrostatic testing can be as much as $1,000 per day, it is apparent that only 2½ to 3½ days reduction in the time to find a leak could pay off the initial cost of charging a pipe line with nitrous oxide. In addition, the re-use of the nitrous oxide test solutions should be feasible. This would cut the cost very considerably.

Field Instrument Needs. With regard to the function of the infrared instrument, it appears that the one used is a rugged and dependable instrument. The instrument is easy to operate. Whenever it indicated the presence of nitrous oxide by audio or visual signal, it was found that the gas was indeed present. Each time an indication was obtained, the probe was removed from the vicinity to a point where no nitrous oxide could be present—upwind, for example—and the dial indicator and audio signal returned to zero. In the course of the work the analyzer was moved about quite a bit over rough pavement without any difficult, except the pulley belt on the chopper motor was jarred out of place on one occasion. Other infrared analyzers are commercially available but were not tested.

Future Possibilities. Although the feasibility of the proposed technique for hydrostatic testing of underground pipe lines using nitrous oxide tracer gas has been demonstrated, much remains to be done to develop a suitable technique for industrial application. Since the cost of nitrous oxide required is an important quantity, it is necessary to fix the least required nitrous oxide to insure rapid location of leaks. A positive means of preparing nitrous oxide solutions of specific concentrations in commercial quantities must be developed so that required test concentrations can be reproduced.

For rational interpretation of test results a relation between the leak rate, the fluid leaking and the concentration of tracer gas detected must be established. Leaks must be defined in terms of the fluid leaking and the rate at which it is lost so that its economic and hazard significance can be defined. This implies that the required sensitivity of the leak detection method will vary in accordance with the fluids to be handled.

A suitable technique or combination of methods will be required to obtain significant samples of air-gas mixture at the surface of the ground above the pipe line. The probe used for the laboratory test would be too small for general field use, because it would probably demand an exorbitant amount of inspection time. The sampling rate and side of probe has, of course, an important bearing on the concentration of nitrous oxide used. It might also develop that subsurface air samples would be preferred and the probe may have to be forced into the ground above the pipe line. Samples could perhaps be taken at the faces of a fresh furrow created by a plow to which a probe is attached.

Results of Experimental Work. From the tests conducted at SWRI it can be concluded that:

A. The use of nitrous oxide tracer gas in the hydrostatic testing of pipe lines is feasible.

B. For industrial use, the method must be developed with particular reference to the following:
   1. Definition of leaks with regard to rate, fluid leaking and the economic and hazard significance.
   2. Relation between the leaks defined above and surface concentrations of nitrous oxide.
   3. Sampling technique and equipment.
   4. Apparatus for producing commercial quantities of aqueous solutions of nitrous oxide in the field.
   5. Design of a leak test procedure.

Additional experimental work will be required to bring the technique to commercial application. But thanks to the favorable results of these studies, there is little doubt of the feasibility of testing for leaks with nitrous oxide and an infrared analyzer.

About the Author

John E. Kaufman is a chemical engineering section manager at Southwest Research Institute where he has been engaged in the fields of absorption refrigeration and leak detection. Previously he worked as a process engineer in the Chemical Plants Division of Blaw Knox Co. in design and construction of chemical and petrochemical plants. He was associated with the petroleum industry for 10 years at the Standard Oil Company (Indiana) Whiting refinery, primarily in technical service work. He has a B.S. in chemical engineering from Columbia University (1941).

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Safety Ideas that Paid Off

Rocky mountainous terrain is typical example of difficult conditions pipe line contractors are faced with on many spreads. From solid rock in Arizona-New Mexico area above to swamplands in Louisiana present a wide range of safety hazards to overcome.

Simple modifications and innovations on equipment and improved instructions for workers go a long way in saving lives and money

By Donald G. De Pugh
Construction Editor, PIPE LINE INDUSTRY

ALTHOUGH CONTRACTORS are unable to eliminate many human factors—which sometimes result in serious accidents—they are continuing to make strides in improving safety measures in pipe line construction work. In some cases, progress is accomplished through simple modifications on equipment—an amber light atop a tractor signifying that it's in motion or a safety latch on crane hook to eliminate possibility of hoist lines from slipping off the hook.

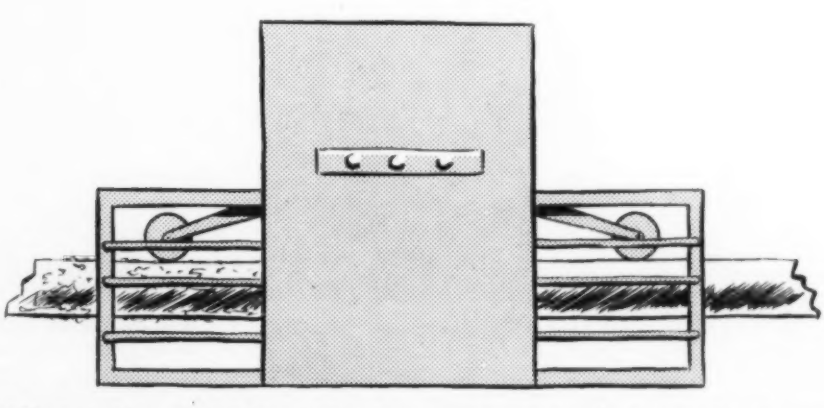
Several such unusual practices recently were revealed in interviews with construction company safety personnel. Most pipe line contractors have the same safety problems and hazards. This report concerns those difficulties common to all.

Make Machinery Foolproof. Although manufacturers have built-in safety features in all new equipment there are still areas where mistakes by a novice employe or even a proven veteran can be costly in lives and money. At one Texas yard a near fatal accident occurred when an operator was pulled into a shot-blast machine while trying to lubricate gear-driven wheels which advance pipe joints into the shot-blast.

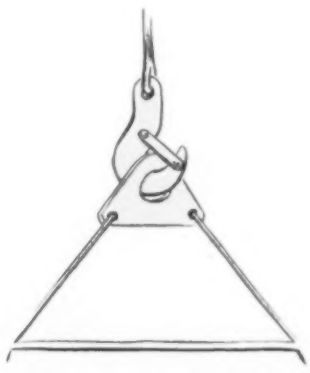
True, the accident was caused through carelessness, but since that incident the company has added crossbars to the guards which extend over the drive shaft and wheels—now it is almost impossible for such an accident to happen.

The most common injuries in pipe line work, as in nearly all construction work, are ocular injuries. Goggles are essential in work around shot-blast, welding, chipping coal tar and asphalt, concrete coating and many other phases. Many workers may neglect to wear goggles because they are uncomfortable. One safety director noted this and replaced the expendable goggles with more expensive, but more comfortable, special-made sun glasses. He found more men wearing glasses and fewer reporting accidents.

"Safety Gate." Here's an example of how a 6-inch piece of steel may save a life. At pipe yards where heavy



Shot-blast machine with addition of bars between drive shaft-spinning wheel and operator makes it safer for all-around working conditions.



Sketch shows crane hook and hoist line with "safety gate" which prevents lines from springing out of hook when crane makes a quick motion.

Making internal weld in double jointing, boom and man enter pipe. While boom is inside, a safety switch prohibits "kick-out" jack from advancing pipe to next station.

cranes load and unload joints of pipe, a spreader bar is generally used to expedite operations. A back injury and an unsettled worker's compensation case resulted from the hoist lines, with spreader bar, "popping" out of the crane hook. A worker was seriously injured when the spreader bar landed on his back, and he has been out of work since March 1959. This hazard was overcome by a simple "safety gate" attachment on the crane hook. By bolting a six-inch steel bar across the hook, the hoist lines can not spring out. When there is a joint of pipe on the hoist lines, the weight of pipe keeps hook and eye taut.

Let's look at another example of how a guard on the machine reduces chances for accidents.

Working around a concrete coating machine, an operator put his hand on the wire brush applicator which revolves at about 2,000 rpm. His arm was pulled into the applicator. It had to be amputated. Guards above the wire brush now reduce hazard of anyone coming into contact with the applicator.

No Riders! Innumerable accidents over the years resulted from workers riding tractors, trucks and other mobile equipment. Falls and collisions resulted in many broken legs, back injuries and even deaths. By making a rule that only necessary personnel were allowed on these vehicles, accidents were sharply reduced for one major firm. Another preventive measure is a rotating, flashing amber or red light, run off the generator, and placed on top of the tractor. This calls attention to the fact that it is in motion.

On a double jointing system which sends a man inside the pipe to oversee the internal pass, the manufacturer incorporated a safety switch on the traveling boom. The switch prohibits the "kick-out" jack from advancing the double-jointed pipe forward while the boom and operator are inside pipe. As the boom is rejected, the switch cuts

If ditch is properly smothered with dirt before blasting, rock will fall back into ditch instead of scattering over right-of-way possibly causing physical damage.

off. Also this assures the operator nothing can happen from the outside; he therefore relaxes and does a better job inside.

Cover Rock with Dirt When Blasting. A contractor blasting his way through rocky terrain discovers many advantages to covering the ditch with dirt before blasting. The blast is more effective and rock is not scattered over the right of way or adjacent property and is less likely to do any physical damage. On one job this contractor was able to blast under high lines by covering the ditch with dirt and keeping rock from flying.

Sharp Supervision Necessary. The heart of a safety program is found in supervisors and foreman. Safety directors stress the importance of their supervisors in informing their crews and enforcing their company rules.

Reminder-signs—"High Wire," "Wear Goggles," "Wear Respirators," etc.—are placed along the right of way, in yards and at stations keeping the idea of safety before all crew members.

The Pipe Line Contractors Association continually aids contractors by disseminating new information, publishing safety manuals and monthly safety bulletins. Safety engineers with insurance companies have worked with pipe line contractors to help them find ways of improving conditions. In submarine work, Coast Guard patrols make spot checks and aid contractors in maintaining standard marine safety protection.

Contractors also attribute improvement in machinery manufacturing with built-in safety features as a major factor in decreasing accidents. Most equipment is recommended by manufacturers for less work than it is capable of—which is a built-in safety factor

In addition to human elements, several natural hazards —wet weather, dust storms, snow storms, allergies, snakes —increase accidents and make it more difficult for the contractors. These will continue to affect contractors safety programs, and probably won't be solved soon . . . nor later.

Safety directors who have cooperated in this report include Carl Lavery, Houton Contracting Company; B. G. Pierce, H. C. Price Company; Paul Wenzel, Rosson-Richards Companies; L. M. Blakey, Standard Accident Insurance Company; Edward E. Smiley, Continental Casualty Company; and Richard A. Gump and Hailey A. Roberts, Pipe Line Contractors Association. —**The End**

Recent Advances in Pipe Line Technology and Engineering

Almost everything in the pipe line industry is being improved. Look what happened last year

By Donald M. Taylor
Engineering Consultant, Houston

PROGRESS MAY COME from the brain, but it usually starts with someone sticking his neck out. This is especially true in the gas pipe line industry where the drives for higher efficiencies spring from sources other than direct competition—the prime motivator in many industries. In the gas industry most times the penalties for the idea that backfires far outweigh the rewards for the one that works!

Some of the new ideas listed below have come as the result of plenty of nerve and unselfishness on the part of engineers with vision. This is especially true in the case of internal coatings.

Internal Coatings for Gas Lines Are Proving Successful

The second report on the behavior of gas flow through internally coated pipe lines will be released soon. According to "pipe line rumors" the new report will be even more optimistic than the first report published in PIPE LINE INDUSTRY last July. The recent tests show that the internal coating is not worsening with age; actually there has been a slight gain in flow rates!

Because an increase of only 2 percent in gas flow can justify the costs of internal coatings, many companies are planning to coat all new lines in the future. In addition, companies are at least considering ways of coating existing lines in place.

It should be pointed out that the advantages of internal coatings were first envisioned by Transcontinental Gas Pipe Line Corp. engineers some five or six years ago. In fact, Transco has been internally coating most of its lines with epoxy resins since 1955 (see PIPE LINE INDUSTRY, March 1955). The results of the tests conducted last year more than justify the faith Transco engineers placed in the slick coatings.

Dual purpose head used for cleaning and coating pipe internally. The roller brush at the top, turns at high speed—1700 rpm—as the assembly is inserted into the pipe which is rotated at 100 rpm. Dust and dirt is sucked from the pipe from a point near the roller. At right is the coating head which sprays material on the pipe as it is withdrawn from the pipe. The cleaning continues during the latter operation.

How Much Does the Coating Increase Flow? Results of tests conducted last spring and summer indicated that the slick coatings gave an increase ranging from 5 to 10 percent depending on the flow rate. At higher rates, the increase was even greater. However, engineers conducting the tests attributed some 4 percent of the increase to the cleaning the line received in preparation for the coating job. This gives a net increase of 1 to 6 percent in the common ranges of flow which can be traced to the coating.

But the greater increases of 5 to 10 percent will continue to be realized if the lines remain clean. There is evidence that the slick coatings do a great deal to keep the line clean internally.

The big prize in the pipe line industry will go to the companies that come up with the most efficient and economical means of coating buried lines internally for the simple reason that there are so many thousands of miles of such which will likely be coated in the next few years. As a result, a number of engineering firms are working overtime developing new coating methods and improving old ones.

Thanks to the chemical "design" of the coatings, the material deposited on the lines is stronger in adhesion than in cohesion. This prevents the resin from coming off in sheets and clogging meters, regulators, valves, etc.

Some Conclusions About Internal Coatings. Most engineers with pipe line companies feel that the best place to apply coating is at the pipe mill. Preparation for the application should be thorough; the mill scale should be removed and the pipe should be dry. The amount of coating should vary between 1.5 mils and 2.0 mils. Any addi-

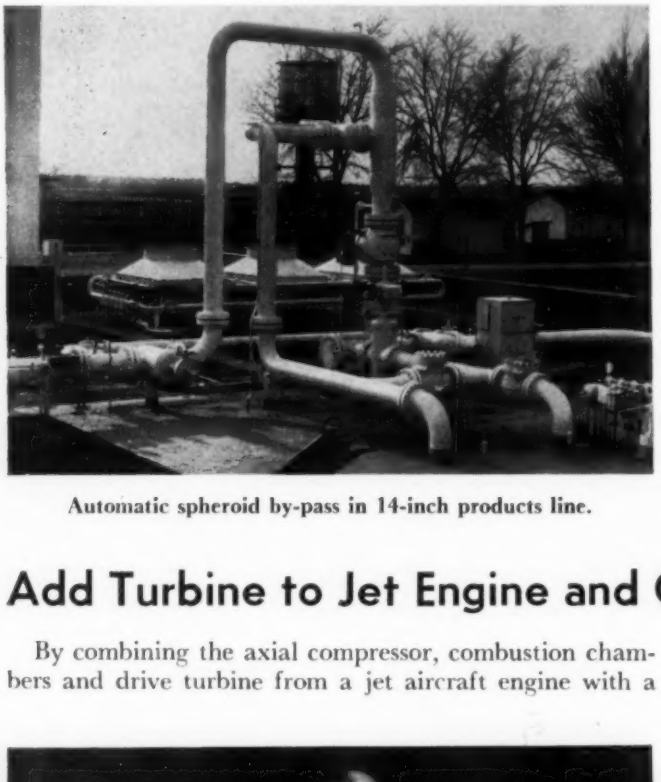
tional coating does not appear to be economically justified. (These thicknesses are the dried and cured measurements.)

My special thanks to Robert M. Johnson, Coast Paint and Lacquer Company, for his help in obtaining information on internal coatings.

Spheroids and Their Many Uses

The most popular piece of equipment to appear on the pipe lines in years is an inflatable elastomer spheroid —or rubber ball! Some pipeliners have come to regard these "new" gadgets as the most important invention in recent years. Their use appears to have no limit so far as pipe lines are concerned.

Launched between tenders in products lines, they are holding interfacial mixing to minimum values. Following hydraulic testing, they are, in many instances replacing squeegees. Several companies are using a pair of spheroids to contain epoxy resin as a slug is moved down the line to coat it.



Automatic spheroid by-pass in 14-inch products line.

Transcontinental Gas is using spheroids to purge distillate from offshore gas lines; and an ingenious piping arrangement facilitates this task. The three lines feeding from producers platforms are 16-inch. At Transco's platform, they feed into a vertical 20-inch header which reduce to 16-inch line as it starts for shore. This makes it possible to start one of the spheroids at any one of the producer's platforms and recover it on shore.

Colorado Interstate is using four sizes of spheroids for on-stream pigging. In running from Laverne, Colo., to Mocane, the pipe line telescopes from 16-inch to 18 to 20 to 24 inches in diameter, and Colorado Interstate manages to pig from one end right on through to the other. The company starts with a 16-inch spheroid at Laverne. Where the line increases to 18-inch, the first spheroid actuates a trip and an 18-inch spheroid is launched immediately behind the 16-inch one. The same thing happens when the line swages to 20 and 24-inch diameter; at Mocane, four spheroids—16, 18, 20 and 24—are recovered in the scraper trap.

There are several remarkable features of the spheroids. For one thing, even though the balls are inflated to ⅜-inch greater diameter than the inside diameter of the pipe, they can be pushed through the pipe with ease.

Moreover, when the spheroids are driving water ahead, there is little leak-by.

Because of the many uses of the spheroids and their ability to round short radius bends, chances are we will see them used to an even greater degree in pipe lines in the future. (For more information, see PIPE LINE INDUSTRY, October 1959, Page 31.)

Add Turbine to Jet Engine and Get 10,500-HP Gas-Fired Turbine

By combining the axial compressor, combustion chambers and drive turbine from a jet aircraft engine with a power turbine of its own design, one engine manufacturer has come up with an unbelievably low cost gas-fired turbine with 10,500 hp!

Model of the new gas-fired turbine which is composed of jet aircraft engine, load turbine and compressor.

Columbia Gulf Transmission Company will install the new turbine—equipped with a centrifugal compressor and automatic controls—at Clementsville, Ky., where it will be remotely operated from the Nashville, Tenn., office. The cost, according to Columbia Gulf President John W. Kelley, will run only 50 percent of the cost of an equivalent reciprocating engine station. From the standpoint of weight, the new turbine set-up will tip the scales at 12 tons (or little over 2 pounds per horsepower) and a reciprocating station equipment of similar horsepower would weigh 356 tons!

One of the novel maintenance features envisioned for the new turbine comes when repairs are needed. The jet engine will simply be removed and replaced with a spare. This job will take about four hours.

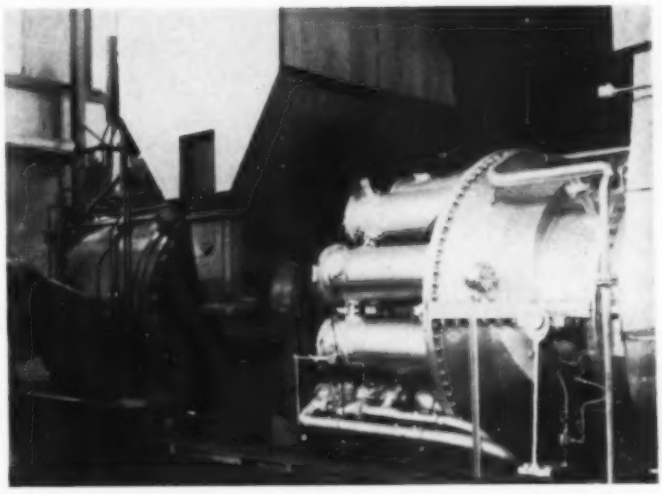
Installation of the new engine is scheduled to begin February 1 and the station is scheduled for a completion in July. The original test run is to be 8,000 operating hours or 18 months whichever period is the longer.

New 13,400-HP Turbines Installed for Less Than $200 Per HP!

Texas Eastern needed four 13,000 to 15,000 hp packages to space between existing stations on its Penn-Jersey pipe line system. Normally the existing stations carried the load, but on cold days, the line capacity had to be increased to bring storage gas from the Oakford storage field to the New York metropolitan area. This called for an "on-off" service which should cost little, initially and operate as inexpensively as possible. Fuel efficiency was not of greatest importance.

Texas Eastern found the answer to the problem in four 13,400 hp single-shaft gas-fired turbines which could be remotely operated from the existing stations. The colder the weather, the better the turbine performance. At 40° F the turbines produced 15,900 hp; at 0° the power could run as high as 18,670 hp!

The units were equipped with two-stage centrifugal compressors and all valves, controls, etc., were either telemetered directly or controlled through automatic sequencing. (See PIPE LINE INDUSTRY, May 1959, Page 26.)

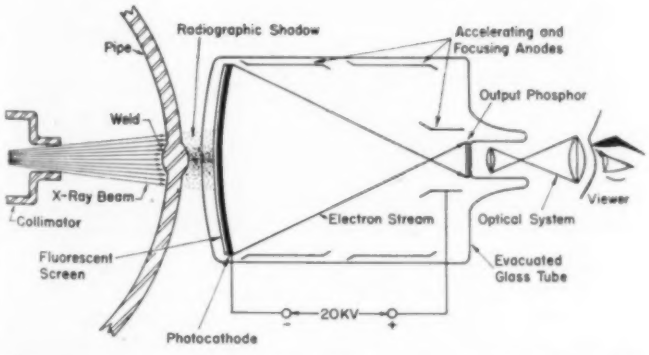


Biggest gas-fired turbines on U.S. pipe lines were installed on Texas Eastern's Penn-Jersey line.

Synthetic Lube Oil Passes Texas Eastern Turbine Tests

A new phosphate ester which can withstand operating temperatures up to 1500° F is proving highly satisfactory for service in gas-fired turbines on the Texas Eastern system. The new lubricants have a higher specific gravity than conventional petroleum lubricating oils. To facilitate circulation the oil must be kept above 70° F and because it is a paint remover, paint was removed from the interior of storage tanks. After 3,000 hours operation with fire resistant lubricant, no trouble has been experienced. (See PIPE LINE INDUSTRY, Sept. 1959, Page 64.)

Continuous Fluoroscope Inspection of Pipe Line



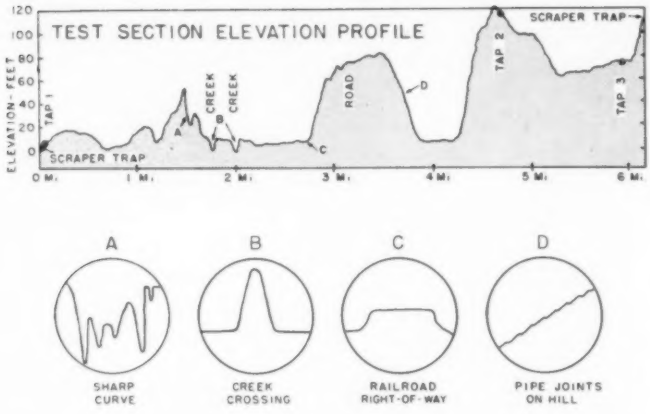
Fluoroscopic image intensifier which converts relatively feeble fluoroscopic images into intense images for viewing.

A new image intensifier makes it possible to inspect 20 joints of line pipe at the mill with a fluoroscope. The new unit has proved highly efficient in detecting flaws in longitudinal welds. While the image is excellent, it still is up to the operator to recognize flaws when he sees them. For this reason, maximum permissible distribution patterns were established for gas pockets, slag inclusion, etc. (See PIPE LINE INDUSTRY, August 1959, Page 26.)

Four-Cycle Engines Drive Pancake Compressors

The Houston Texas Gas & Oil stations utilized a design that is becoming more and more popular throughout the industry—a four-cycle gas engine driving a pancake type compressor at the end of the drive shaft. The economy of this installation is breaking records for reciprocating engines. (See PIPE LINE INDUSTRY, May 1959, Page 18).

Pressure Recorder Pig Shows What Goes on Inside a Pipe Line



What the pressure sensitive pig records under various conditions.

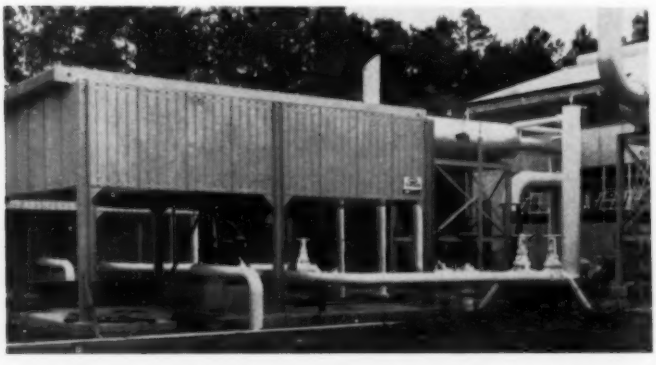
A pressure sensitive pig records continuously as it traverses a pipe line. Measurable variables which it records are: grade, curvature, roughness, pressure, temperature, leakage and possibly electrical potential. Even though the instrument needs improvement, it can still render valuable studies showing what goes on inside a line, as the accompanying illustrations show. Further study will be required to record corrosion pitting or electrical potential. Studies with this type recorder are still being carried out. (See PIPE LINE INDUSTRY, June 1959, Page 62.)

Improved Line Pipe Is Available

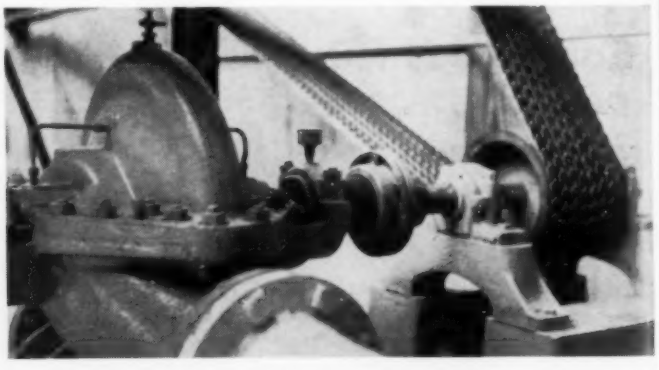
One company decided it needed X-56 for a certain job not long ago. But after confering with its metallurgical engineer, it found that about 80 percent of the pipe it had been getting was actually X-56 or simply upgraded X-52 pipe. So actually our switch to better pipe will not amount to much at this time. (See PIPE LINE INDUSTRY, January 1959, Page 26.)

Using Jacket Water for Hydraulic Fan Drives

One of the novel ideas on the Houston Texas Gas & Oil and Coastal Transmission systems was the means used to drive jacket water and lube oil cooling fans on the atmospheric coolers. The jacket water itself was used to power the hydraulic turbine. What is the advantage? Primarily it is one of convenience and lack of duplication in piping. The jacket water obviously has to be piped to the coolers—why not let it give up 40 horsepower or so to drive the fans. (See PIPE LINE INDUSTRY, May, 1959, Page 18.)



Atmospheric cooling fans are driven by jacket water which is part of cooling load. This saves piping.



Actual turbine driven by the jacket water. This takes about 40 horsepower form the jacket water pump.

Some of the Advances in Automation

For some years the pipe line industry has been committed to attaining a high degree of automation, there has been little to impede this movement. Petroleum refineries, petrochemical plants have been run by instrumentation for years and certainly they deal in high pressures, high temperatures, etc., which are more hazardous than those of the contents of most pipe lines.

In products, crude and gas lines fully automatic, remotely controlled stations are now fairly common. El Paso Natural has a remotely operated station controlled via microwave (see PIPE LINE INDUSTRY, November 1959, Page 40) and Magnolia, Wolverine, Plantation, Laurel, Continental and many other crude and products lines are highly instrumentized throughout and have automatic pump stations which are remotely controlled. (See PIPE LINE INDUSTRY, November 1959, Pages 47, 54 and 64.)

Pipe Line Pete's

IDEAS FOR THE FUTURE!

. . . in pipe line engineering, construction and operations

By **Donald M. Taylor,** Engineering Consultant, Houston

How to Memorize the 1960 Calendar

You can tell the day of the week of any of the 366 days of 1960 without a calendar if you will memorize the 12 numbers given below and be willing to perform a little mental arithmetic. It's simple. My 10-year-old son, Larry, learned this trick last year to impress his arithmetic teacher, and he is a much better Little League pitcher than egg head.

First, each month has an individual number. Here they are:

January	5	July	5
February	1	August	1
March	2	September	4
April	5	October	6
May	0	November	2
June	3	December	4

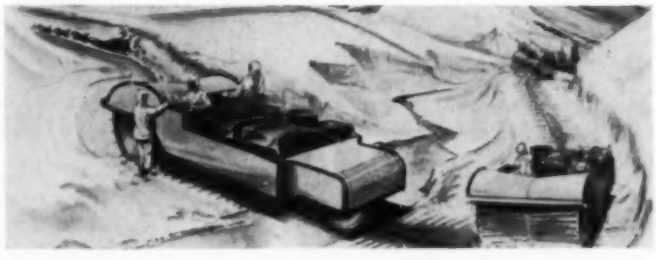
Once you've related these numbers to these months, simply add the number to the day you want to look up and divide by 7. Count off the remainder starting with Sunday as 1, Monday as 2, Tuesday as 3, etc. Saturday as 7 (or 0).

Example. What day of the week will July 4 come this year?

Solution. 4 + 5 = 9. Divide by 7; the remainder is 2. July 4 comes on Monday. How about November 12? Add 12 + 2 = 14. Divide by 7 and you have a remainder of 0 or 7. November 12 comes on Saturday.

What about Christmas? Add 25 + 4 = 29. Divide by 7 and you have a remainder of 1. Christmas comes on Sunday.

Giant Amphibious Cargo Vehicle Developed



"Mush!"

—and 150 tons of cargo starts inland across the Alaskan countryside. But this time there'll be no barking huskies pulling a sled behind a human trail breaker scuffling along in snow shoes. Instead, there'll be the smooth throb of diesel power as a gigantic cargo vehicle crunches through the crusted snow and ice and heads toward the mountain pass. It makes no difference if there are no roads because the carrier will be too big for the roads anyway.

Its front wheels (or drums) will measure 10 feet across and they will be 25 feet in diameter. They will be spaced 16 feet apart. The back wheel is a sphere with a flange around its circumference which will guide the vehicle in water, on land or snow. Lugs on the front wheels propel the craft when it is in water; the same lugs give the wheels a grip on snow.

The purpose of this vehicle will be to provide transportation to inland cities and mines and to bring the treasured minerals from there to the outside world. In addition, the vehicle will be used for construction. Pipe lines to bring gas and other fuels to what is now remote country will not be long in coming once the transportation problem has been whipped.

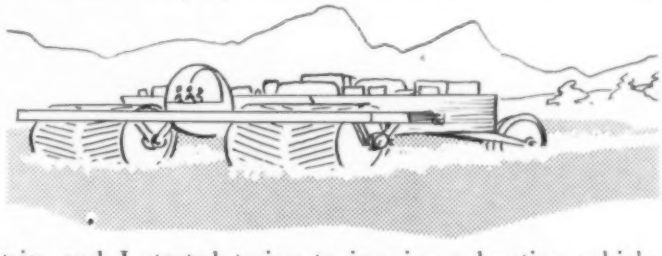
Is this just a pipe dream?

Nope. The prototype model which is rated at 6 tons of cargo is nearing completion and before the month is out it will be making its trial runs.

If this idea seems unusual—it is only natural because it comes from an unusual man. Weldon Appelt, one of the industry's most creative engineers, has a way of thinking up unusual things and making them work (see December PIPE LINE INDUSTRY, page 27).

What caused Appelt to dream up this super kiddy car?

"Pure laziness," he explains. "I got tired of chasing those darn sheep up and down mountains on a hunting



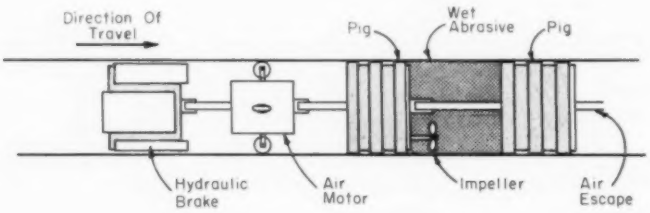
trip, and I started trying to imagine a hunting vehicle which could swim, wade snow and climb mountains. The thing got out of hand; I'm calling the resulting vehicle the TRAILBREAKER."

Vital statistics: the first model—which is the medium-class, 6-ton vehicle to be used for personnel and light cargo—will be powered with a new V-6 180-hp industrial diesel engine. Front drum—7 feet in diameter and 8 feet wide; the rear sphere is 6 feet in diameter. The large 150-ton three-wheel vehicle will be powered by two 600-hp engines—one per drum.

New Tools Tested for Internal, In-Place Coating

One of the big prizes in the pipe line industry will go to the engineering firm that comes up with a wholly successful and economical means of internally coating gas lines in place. Rosson-Richards engineers, long cognizant of pipe line problems have been working overtime on four pieces of equipment for cleaning, coating and testing the coating inside existing gas lines. Preliminary tests of the equipment look good, and likely the first real tests will come this spring when the demand for gas slacks off enough to permit the coating operation. Here are the four units which will be tried:

Wet abrasive cleaning. Cleaning is the most important aspect of internally coating a line in place. The best means Rosson-Richards has devised for cleaning is an abrasive liquid cleaner, trapped in a "tank" between two

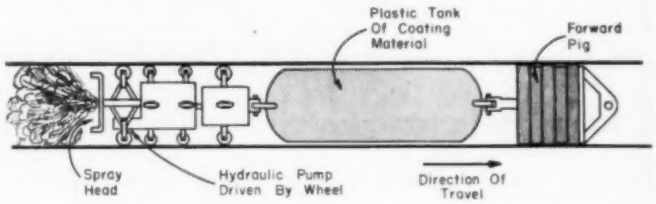


Forward Progress 1/2 M.P.H. To 5 M.P.H.

pigs and agitated with an air-motor-driven impeller turning up at 2,500 rpm. The rear pig has a built-in hydraulic brake which holds the machine to ½ to two miles per hour, and there is a vent arrangement which lets gas or air escape through the air motor and up ahead of the lead pig.

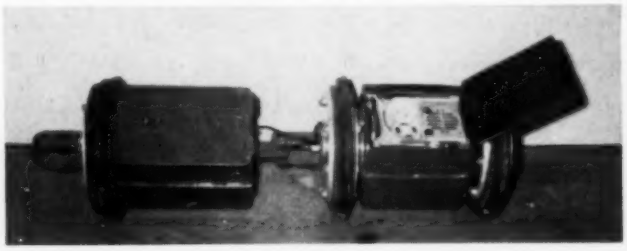
Wire brush cleaning machine is powered in a similar manner. The motive gas drives a pneumatic motor which rotates the brushes etc., used in cleaning.

The coating machine is a completely self-contained unit which is pulled through the line by a lead pig. The coating material follows right behind the pig inside a plastic pipe tank and behind this comes the paint gun. One of the wheels which supports the spray gun drives a



hydraulic pump which forces the spray through the nozzles on the gun. The coating and pipe are electrostatically charged so there is an electrical potential between the epoxy coating and the steel pipe. This is used on lines 16 inches and less in diameter.

Mil thickness and holiday detector. This completely electronic unit is contained in a pig which traverses the line the day after the coating has been applied to evaluate the quality of the job. Its developers say it can accu-



rately measure coating thickness in the order of ⅕ a mil and it also records the approximate location of holidays on the tape.

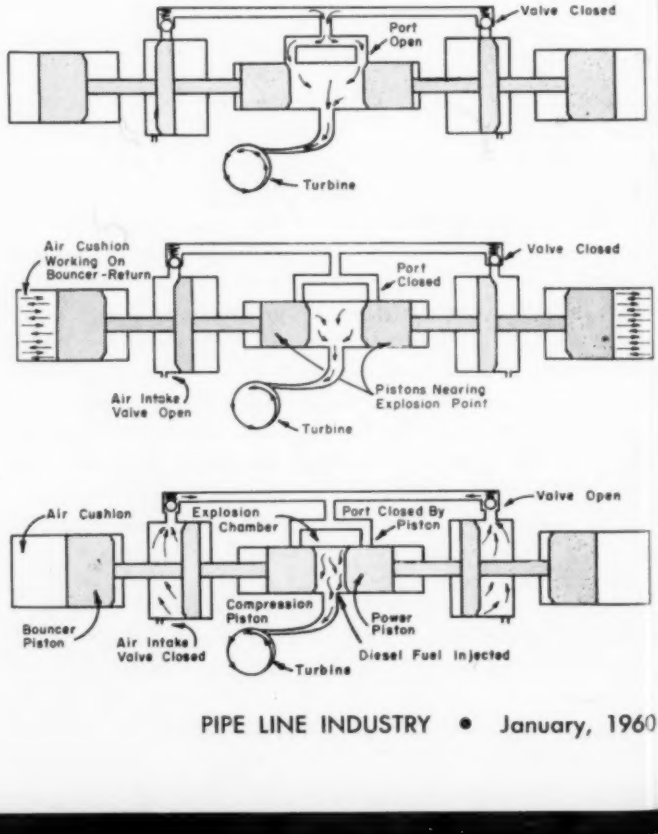
Battery of 15 Free Piston Engines Drives Compressors

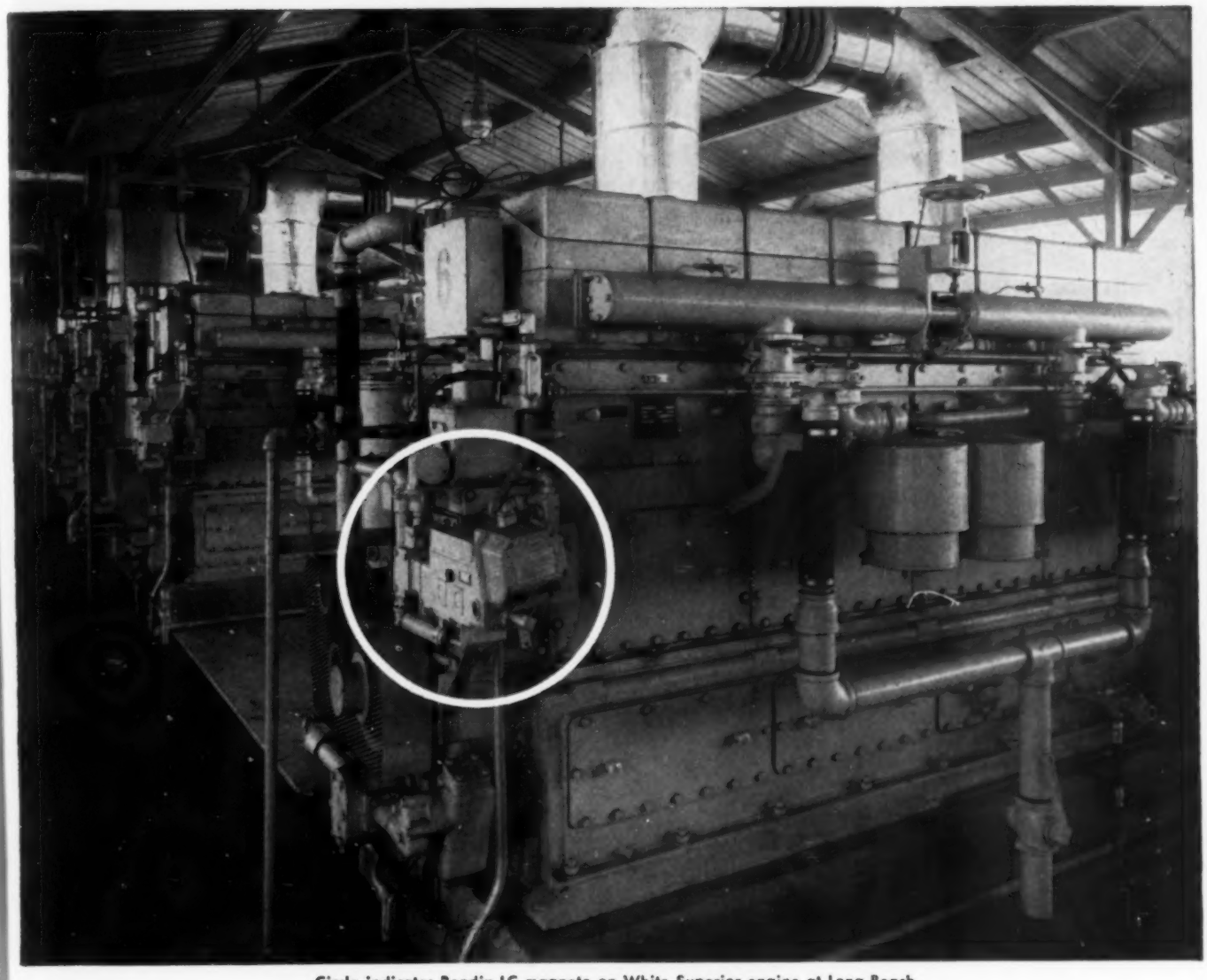
A battery of 15 free piston engines are generating hot gases which in turn drive turbines that power centrifugal compressors in a new Imperial Chemical Industries plant in northeast England.

This is a big breakthrough in the engine field. Several companies have been working on development of such an engine for the past 7 years. Slowly the bugs (lubrication difficulties and excessive wear on the bottom of the cylinders, to mention a few) have been eliminated or minimized. These particular engines were made by the French firm, Société Industrielle Générale des Méchanizues Appliquées.

The free piston gas generators have two opposing pistons in the same cylinder, as they approach one another they compress the air between them. When the proper pressure is reached, diesel fuel is injected into the cylinder and ignition occurs. The pistons fly apart, and the hot gas escapes to perform work in the turbine. Bounce pistons cushion the drive and reverse the pistons as shown in the drawings.

Temperature of the gas leaving the generator is 840° F; pressure is 45 psig.





Circle indicates Bendix LC magneto on White Superior engine at Long Beach.

BENDIX LC MAGNETOS HELP POWER GIANT LONG BEACH WATER-FLOODING PLANT

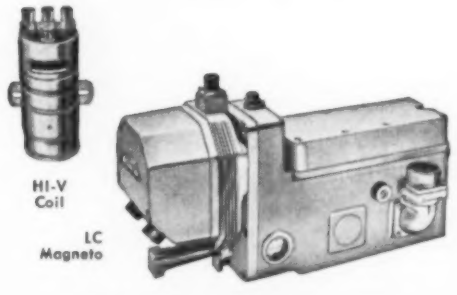
Long Beach, California, operates what may become the world's largest water-flooding plant—drawing water from the Pacific Ocean and pumping it into the Wilmington Tract beneath the city. The additional pressure created will aid in oil recovery and, it is hoped, will reduce land subsidence in the area.

Currently operating at a rate of 120,000 barrels per day, the capacity will be increased and may eventually reach 1,000,000 barrels per day—which would make it the world's largest project of its kind.

The plant is powered by eight White Superior gas engines equipped with Bendix* LC magnetos and HI-V transformer coils. These matched ignition systems, noted for long service life, simplified maintenance at low cost and complete operating reliability, can be used with engines of from six to sixteen cylinders.

If you want to know why major operators are specifying Bendix LC Ignition, write SCINTILLA DIVISION, BENDIX AVIATION CORPORATION, SIDNEY, NEW YORK.

*REG. U.S. PAT. OFF.



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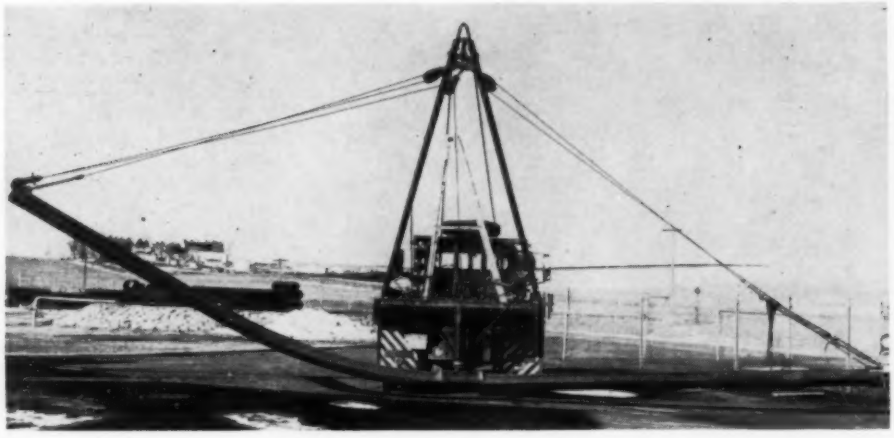


Bend Pipe Up to 12-inch Diameter With a Winch-Truck

The industry has fine pipe bending machines for all sizes of pipe. In addition, side boom tractors have proved effective along these lines with pipe up to 12¾ inches in diameter.

But what of the pipeliners who are faced with the task of bending small diameter pipe without the services of either a pipe-bending machine or a sideboom tractor? Must they always seek out large trees etc., or hire expensive equipment to do the job? Men in one pipe line maintenance gang in the northern United States thought not. They devised this simple and inexpensive means of bending pipe up to 12¾ inches in diameter.

Here's the way they made their bending machine.

First they fabricated bending shoes of various diameters. These are identical with those commonly employed on sideboom tractors. They fit the outside contour of the pipe and they are flared slightly at the ends. A heavy hinge-half on top of them provides the necessary flexibility.

A pipe stanchion, which fits beneath the tail gate of the truck, resists the upward movement of the shoe during bending. The accompanying photo shows the details of this member.

To bend pipe with this device, hook the shoe to the back end of the truck as shown; dog off one end of the pipe with a snatchblock and chain; then, using three snatchblocks—two on the A-frame and one at the end of the pipe—winch the pipe to the proper degree of bend. From time to time, the pipe will have to be adjusted in the shoe to prevent wrinkles.

Closure for Open Pipe Ends Easily Made From Scrap Steel

A pipe closure that keeps dirt, small animals, children, etc., out of stored pipe or constructed sections of pipe line can be readily made from scrap steel as shown. This "night cap" or cover plate can be made by simply cutting a circular plate the same size of the pipe from scrap steel.

Using steel bar or strap, make a "V" type foot with a little crook at the top ends, and weld it on the back of cover plate near its center. Let two points of foot be opened about half-inch greater than pipe internal diameter. This will produce a slight spring force to hold the blind cover on the open pipe end. This type of self-hold cover is easy to handle.

It was designed by a maintenance and construction engineer with the Chinese Petroleum Corporation on Formosa.

Use Sandbags to Stabilize Transits on Slick Floors

Take the problem of making transit shots inside an existing compressor building. If the engines are running, vibration is intense. Moreover, the floors are usually slick and polished. The transit simply will not hold still long enough to make the shot if the metal "feet" are on the bare slick floor. Besides crews take a dim view of such proceedings—the floor is their symbol of good housekeeping.

There are several solutions to this problem. Here are two: First, cut up a large cardboard box and make a triangular mat for the transit. Cut a hole in the center so the plumb bob can be centered over the shot point.

A second method is to fill three sacks with dirt or shot; place them under the legs of the transit. This method has several advantages of the first. It reduces the tendency of the transit to "walk" with the vibration. In addition, the dirt dampens the vibration. Also, it enables the instrument man to set his transit up over points which require the legs to be in different planes—such as on stairs, etc.

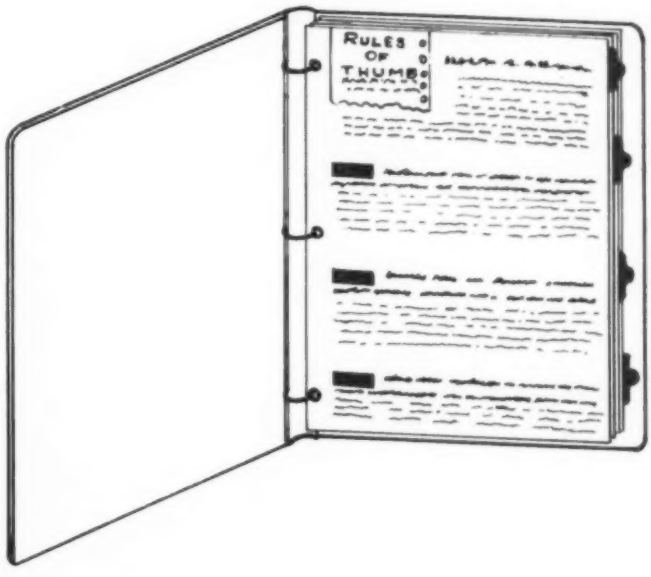
It should be pointed out that these measures may prove expedient in other places than compressor building floors. Three shot-filled bags could prove very useful to instrument men involved in station construction.

Make a Notebook of Your Pipe Line Rules-Of-Thumb

Ahem!

One of our readers wrote: "I have been having a problem using the Rules of Thumb from your magazine, and I thought you might like to pass along my solution to your readers. My problem was how to combine the new Rules of Thumb printed monthly with the bound booklet I got with my subscription to PIPE LINE INDUSTRY.

"My solution was to make a combined notebook of the two. First I made an 8- x 11-inch cardboard template with three holes punched for binding. I use this for cutting the pages from the magazine. Also, I cut the sheets from the bound book I received from you; trimmed them with the template; and placed all of them in a loose leaf notebook. I use cardboard dividers to separate the various categories. To make the latter handier I cut out block titles, 'Engineering Design,' 'Pipe Line Construction,' 'Corrosion Protection,' etc., from the magazine and mounted them in index tabs. When two of the items are published on a page, I trim them out and mount them on sheets of typing paper with scotch tape and insert them in my notebook."

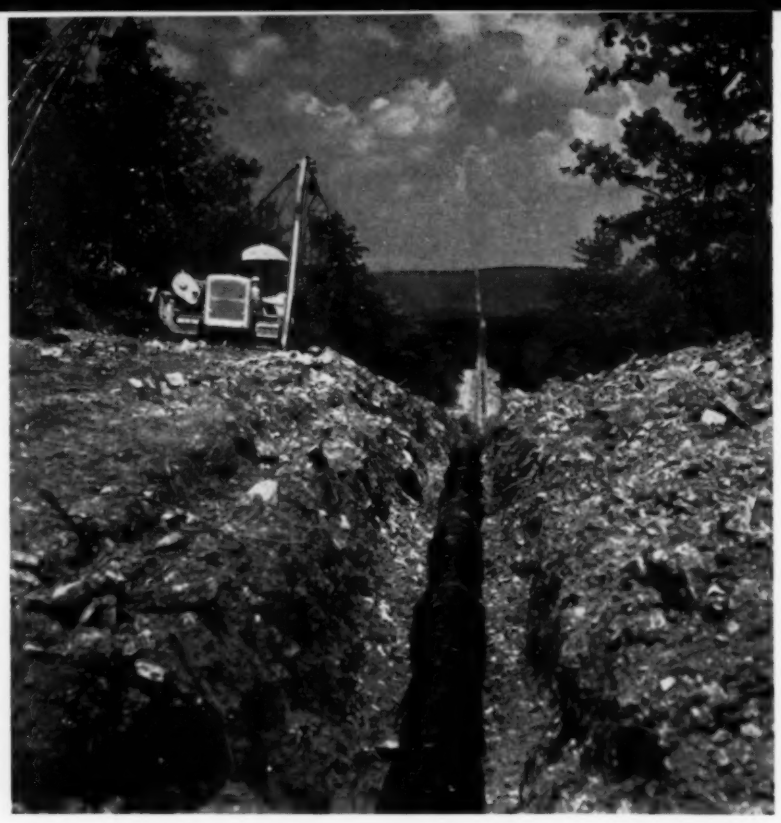


Many thanks and $10 to an interested reader.

Extra Switch on Radio-Equipped Vehicles Prolongs Point Life

Install a push-pull switch on the dash board of company automobiles equipped with radio transmitters. It will prevent this occurrence: When the ignition is left on to operate the radio, there is a normal additional drain on the battery. If the points in the distributor happen to be making contact, there is an added drain on the battery, and, chances are, the points will be burned.

The simple solution is to install a push-pull switch on the hot wire going from the ignition switch to the distributor. The cost—about $1.

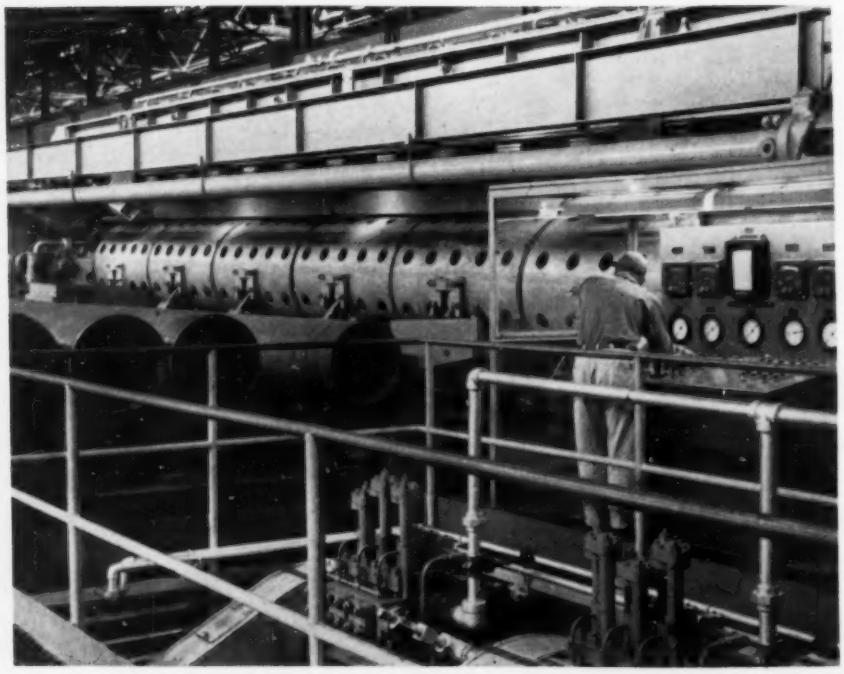


Industries near Hot Springs have a new and greater source of natural gas to rely on with the completion last fall of Arkansas Louisiana Gas Company's newest addition to their extensive pipeline system.

Almost a hundred miles long, the new 16-in. line starts from Aetna Field in western Arkansas and runs almost straight-a-way southeast over Magazine Mountain to terminate at Ark-La's mainline junction near Jones Mills in central Arkansas. The Bethlehem electric resistance-weld pipe used in the line met the .250-in. wall, API 5LX, Grade X-46 specification in every length, and successfully passed the hydrostatic test of 1,000 psi, full operation pressure.

On the highest peak in Arkansas or under the streets of St. Petersburg

You can count on Bethlehem line pipe



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The City of St. Petersburg added to their natural gas distribution system last summer with the installation of a new 12-in. line. Laid in sandy soil along tree-shaded streets, the line went in quickly and tested out perfectly, all due to three factors: sound planning by Stone & Webster Service Corporation, New York, N. Y.; expert pipe-laying practices of Aldridge-Poage, Inc., Lexington, Ky. (now operating under the name, Poage Construction Company, Inc.); and the uniform high quality of Bethlehem electric resistance-weld steel pipe. Industrial Supply Corp., Tampa, Fla., was the pipe jobber.

BETHLEHEM STEEL

BETHLEHEM STEEL

Rules of Thumb

and Engineering Data Sheets for the Pipeliner's field notebook

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Engineering Design —71— How to size crude and products lines for capacity increases.

Any new pipe line for crude or products should be sized to carry 2/3 of its ultimate capacity. This is based on the fact that most new lines in the U. S. are sized this way according to a report, "Transportation of Oil," published by Petroleum Administration for Defense, Dec. 1951.

Example: Here's the way it works out. Suppose you are to design a line to take care of an initial capacity of 100,000 barrels per day. This could be done by laying a 16-inch line and spacing some 14 pump stations along its length. But to increase it 50 percent or to 150,000 barrels per day, it would be necessary to add intermediate stations—14 in all. Excessive operating costs would likely result.

However, if the line were designed so that the 100,000 barrels per day tallied up to only 2/3 its ultimate capacity, a 20-inch line with five original stations would be installed. To increase this capacity to 150,000 bpd, it would be necessary to add only five stations.

This is based on an estimate that **when expanding the capacity of a line, loop it if the increase is to be greater than 50 percent of the original capacity. If it is to be less, simply add horsepower.** This, too, often holds true.

Both of these approaches are based on statistical results, rather than on economic studies, etc.

Engineering Design —72— How to size lines, estimate pressure drop and optimum station spacing for crude systems.

This table will give "horseback" estimates as to optimum line size, pressure drop and pump station spacing for crude oil of approximately 40° API gravity and 60 SSU viscosity.

The depreciation was assumed to be 6 percent straight line; return on the investment 8 percent, and capital and operating costs were based on current Mid-Continent averages:

FOR	USE		
Thruputs (Bbls. per day)	Pipe Diameter (inches O.D.)	Pressure Drop (psi per mile)	Pump Station Spacing (miles) (For 800 psi disch. Press.)
0 to 2,000	3½	..	...
2,000 to 3,000	4½	32	25
3,000 to 7,500	6⅝	16	50
7,500 to 16,500	8⅝	10.5	76
16,500 to 23,500	10¾	8.5	94
23,500 to 40,000	12¾	7	112

Line Cleaning

Continued from Page 30

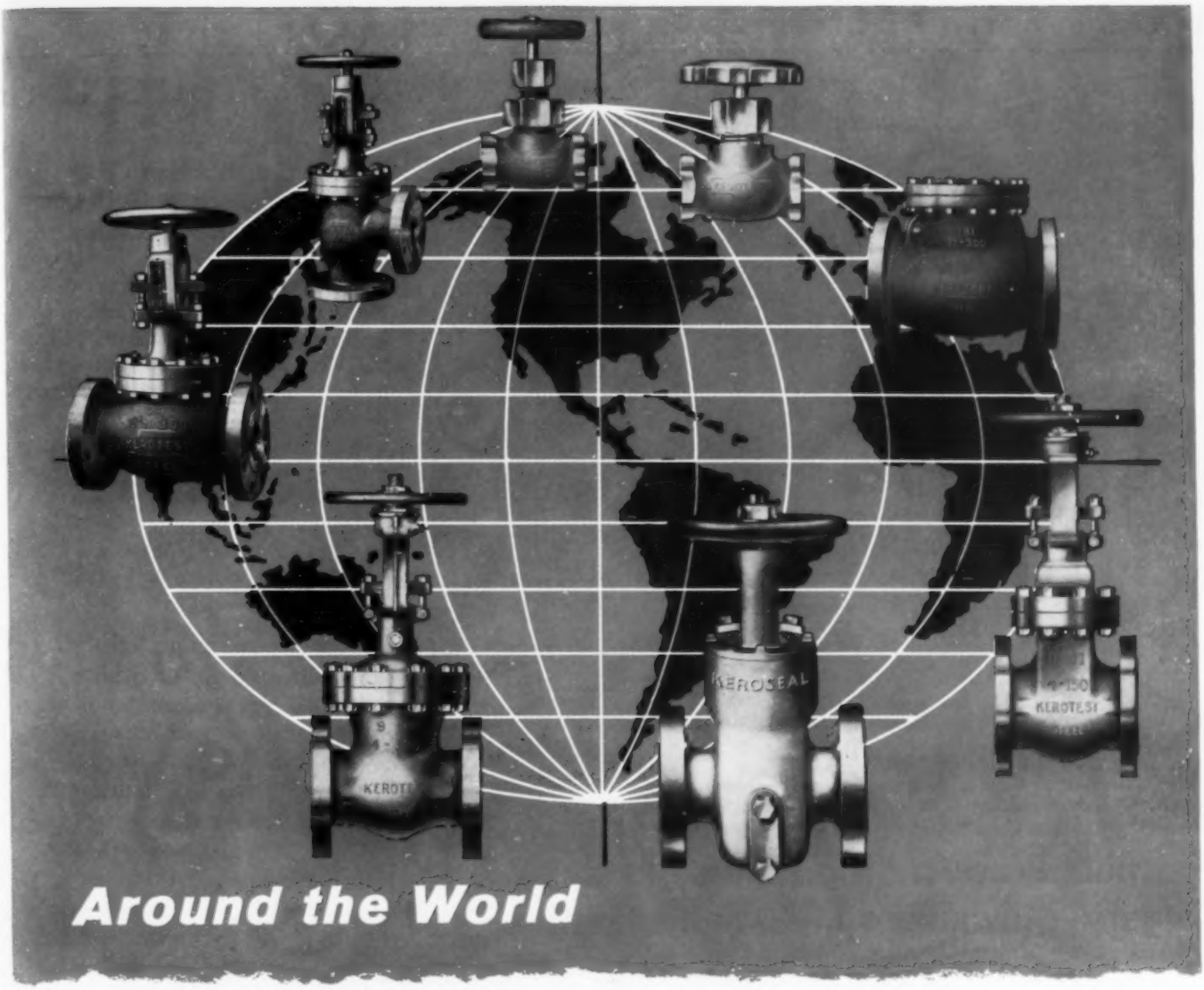
dirt and carry it ahead of the cleaning instrument to prevent scratching the surface. No amount of gas sweep will remove adhered particles of dirt ahead of the cleaning instrument. Further tests show that a 1,000 foot water column with up to 30 pounds of detergent per thousand gallons of water will effectively restore the glassy surface of the internally coated pipe. Scratches caused by the cleaning instrument breaking off weld icicles cannot be prevented.

Any amount of dirt picked up in construction is too much to tolerate when being dragged across the glass-like surfaces by the cleaning instrument. The coating was applied at great expense to the company; scratching can reduce its effectiveness up to 30 percent. If any grit is left in the pipe or is introduced through gas well connections, numerous on-stream squeegee runs may wear the coating from the bottom of the pipe, producing a further decline in efficiency.

The day of high pipe line efficiencies is being realized through internal coating but internal cleaning via brute force and awkward methods must be abandoned if we are to realize the full benefits from internal coating.

About the Author

Clinton McClure is one of El Paso Natural's senior engineers. He has been with this company since graduating from New Mexico State University in 1949 with a B.S. in mechanical engineering. He has participated in pipe line flow efficiency testing; maintenance engineering and this study on pipe line cleaning techniques. He is a member of the AGA Transmission Committee, AGA Pipe Line Efficiency Committee NB-13 and other professional societies.



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WHAT'S HAPPENING

IN PIPE LINE CONSTRUCTION

By Donald G. DePugh, Construction Editor

British Petroleum Completes Pipe Line

Pipe is lowered in ditch on final stage of construction of British Petroleum Company's 60-mile, 18-inch crude line from Angle Bay to Llandarcy refinery, near Swansea. Annual capacity of Britain's longest pipe line is 5 million tons.

Foothills Products Pipe Line Plans Calgary-Milwaukee LPG-Sulfur Line

Studies are being made on a sulfur-LPG pipe line from Canada to Milwaukee and crude facilities to move oil from North Dakota through Canada to Minneapolis-St. Paul.

Foothills Products Pipe Line, Ltd., is considering the sulfur-LPG line from Calgary to Milwaukee. Sulfur, butane and propane would be transported either in a single pipe line or two separate lines. If LPG could be used as a liquid for the sulfur slurry only one line would be necessary; otherwise propane and butane would move through one line and the slurry in another. Estimated cost of the project is about $190 million.

The crude oil proposal considers laying a line from fields in Northern North Dakota connecting to the Interprovincial Pipe Line Company terminal at Cromer, Manitoba. Crude would be transported to Minnesota through Interprovincial's system and a crude line would carry it to the Twin Cities area.

A line also could be constructed to deliver crude from Minneapolis-St. Paul area to Chicago.

Presently under consideration is a pipe line from Alberta to Chicago which would be built by Mid-Continent Pipe Lines Ltd.

Peace River Granted Permit To Construct 255-Mile System

Peace River Oil Pipe Line Ltd., has been granted permit to construct a 255-mile crude line system to serve northeastern British Columbia fields. The 8-inch line will extend from Beatton Creek, B.C., to Valleyview, Alberta. Cost of project which includes 13 miles of gathering lines in British Columbia is $8.6 million.

CORRECTION

There was an omission in the article, "New $3000 Instrument Locates Buried Rock" on page 34 of the December 1959 issue of PIPE LINE INDUSTRY. The formula for computing depth of changes in consolidation should have read:

$$D = \frac{X_c}{2}\sqrt{\frac{V_2 - V_1}{V_2 + V_1}}$$

Collins Construction Co. Completes Persian Gulf Line

Collins Construction Company has completed construction of 19-mile, 30-inch submarine crude line from Khargu Island in the Persian Gulf to Ganaweh on the mainland of Iran. Collins earlier had completed a 3-mile, 30-inch pull from Khargu to Kharg Island. The offshore line was the final section of a major expansion project completed in Iran. It connects with Iranian Oil Exploration and Producing Company's 26-28-inch, 72-mile crude line from Gash Saran oil fields to the shore.

Construction Scheduled For 1960 on Katy LPG Line

Construction is scheduled to begin early this year on the Missouri-Kansas-Texas Railroad LPG system from Texas Panhandle to Minnesota-Wisconsin markets.

The 1,400-mile, 8-12-inch line is Katy's new proposal for an LPG system; earlier it had made studies on a line from Houston to New York. Carrying propane, the $60 million system will serve refineries in Kansas, Missouri, Nebraska, Iowa, Minnesota and Wisconsin. Williams Brothers has the contract for engineering and feasibility studies.

The line will extend from the Panhandle to McPherson, Kan., from there two separate lines run to Minnesota and Wisconsin. Katy plans to lay the main line to McPherson by mid-year and the complete system by the end of 1960.

Westcoast Completes 25-Mile Gathering System Extension

Westcoast Transmission Company Limited has completed a 25-mile gathering extension to its British Columbia system. Marine Pipeline & Dredging Company completed work ahead of schedule on the project. Westcoast will take gas from Jedney-Bubbles gas fields; initial deliveries from Pacific Petroleums Ltd., will be 50 MMcf of gas daily.

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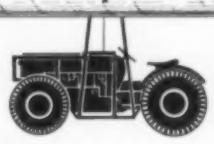

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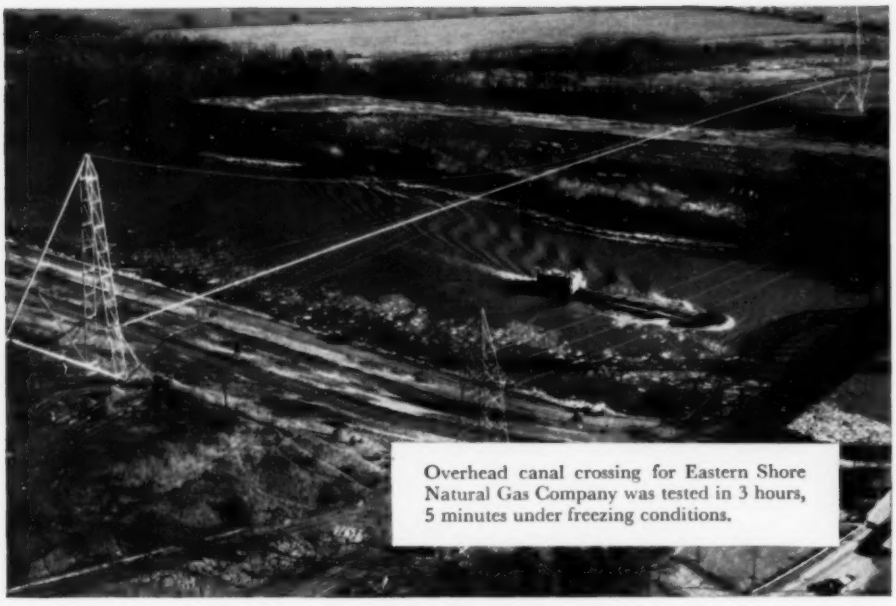
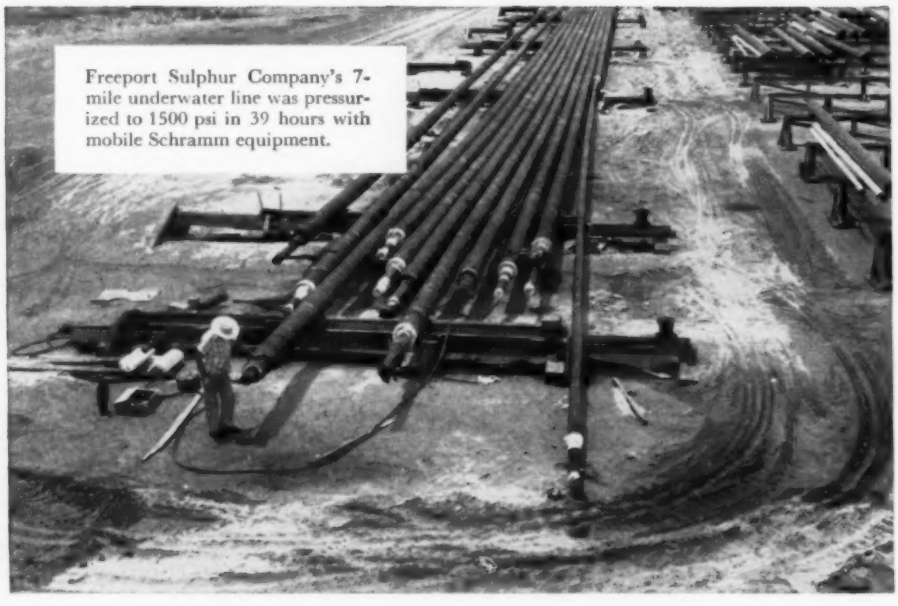


Overhead canal crossing for Eastern Shore Natural Gas Company was tested in 3 hours, 5 minutes under freezing conditions.

...and tested them deep



Freeport Sulphur Company's 7-mile underwater line was pressurized to 1500 psi in 39 hours with mobile Schramm equipment.

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Transco Seeks FPC Permit On 29-Mile, 20-Inch Line

Transcontinental Gas Pipe Line Corporation is requesting FPC authorization for construction of 29 miles of 20-inch gas line, a metering station and 2,500 horsepower addition at an existing station.

The line will be laid in Texas to take gas from South Texas Natural Gas Gathering Company at a point in La Salle County. Cost is about $2.4 million.

Shamrock Oil & Gas Corp. Building 70-Mile Gas Line

Shamrock Oil & Gas Corporation will construct a 70-mile, 16-inch gas line from Ellis Ranch field to the company's plant in Moore County, Texas.

Completion date is scheduled for June 1.

Construction Underway On Trans-Iranian Stations

Construction has begun on addition of seven pump stations along the Abadan-Tehran Trans-Iranian pipe line.

The additional stations will bring thruput of the line to 2.2 million metric tons per year.

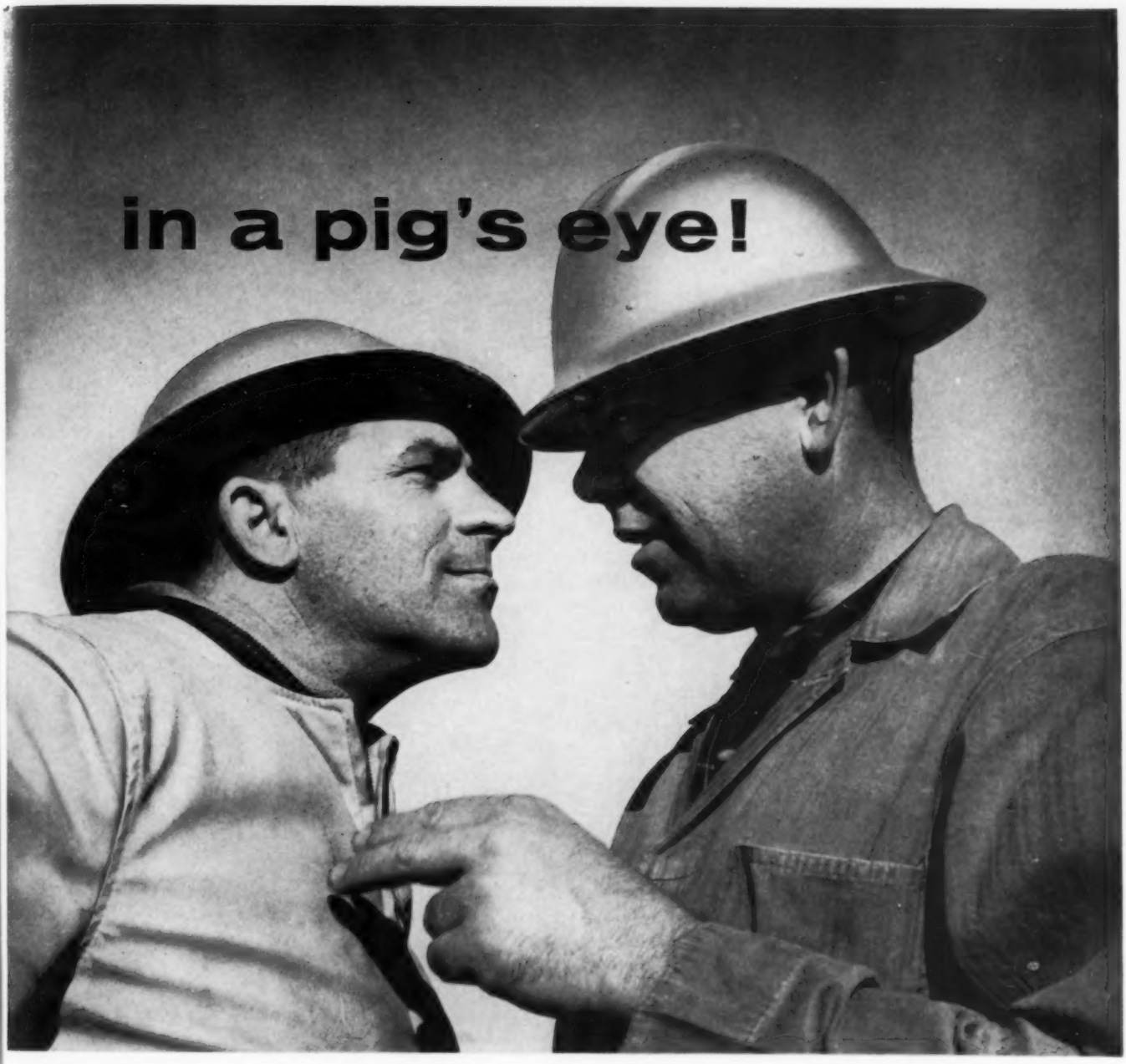
Federal Power Commission Approves Several Projects

Projects by Kansas-Nebraska Natural Gas Company, American Louisiana Pipe Line Company, Transcontinental Gas Pipe Line Corporation and Lone Star Gas Company have been approved by the Federal Power Commission.

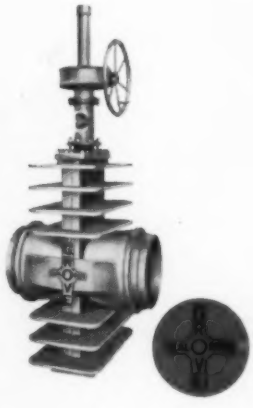
Kansas-Nebraska will lay 15 miles of 12-inch loop line and install 4,800 horsepower in new and existing stations at a cost of $1.5 million. Other companies were authorized to construct facilities during 12-month period to enable the companies to take gas into their main lines from independent producers.

Chilean Agency Plans 60-Mile Crude Pipe Line

A 60-mile crude line to the Puerto Sara terminal will be constructed by Chilean state oil agency, ENAP.



THERE IS A DIFFERENCE IN VENTURI VALVES



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Pacific Lighting, Transco, Pemex, Texas Gas Let Contracts

Pacific Pipeline Construction Co. has contract to construct 116 miles, 34-inch main line for Pacific Lighting Gas Supply Co. Extending from near Topock, Ariz., to Needles, Calif., the line will connect to Transwestern Pipeline Company's system.

Panama Williams Corporation will construct 15 miles of 30-inch gas loop line near Houston for Transcontinental Gas Pipe Line Corporation.

Engineers Limited Pipe Line Company has let contract to Bechtel Corporation for double jointing 79 miles of 26-inch pipe line near Lafayette, Ind. Engineers Limited is laying main line loops for Trunkline Gas Company.

R. H. Fulton & Company will lay 126 miles of 30-inch loops for El Paso Gas Co. in New Mexico.

Williams Brothers Company is laying 23 miles of 30-inch gas loop line for Transcontinental Gas Pipe Line Corporation near DeQuincy, La.

Contract has been let to Mischer-Golightly, Inc., to build a 27-mile, 10-inch jet fuel line for Humble Pipe Line Company.

Houston Contracting Company presently is constructing 11 miles of 20-inch for United Gas Pipe Line Company in Ascension and Iberville Parishes, south of Baton Rouge, La. Houston also has contract for 27 miles of 6-inch products pipe line for Texas Gas Transmission Corporation. Line runs from Woodlawn to Eunice dehydration plant in Louisiana.

Sharman, Allen, Gay & Taylor has contract on 114 miles of 24-inch gas line for Petroleos Mexicanos. This is part of Pemex's 500-miles gas line from Pemex to Mexico City.

Sam Carline, Inc., is laying 20 miles of 12-inch gas line for Texas Gas Company in Louisiana. Line extends from Baldwin, La., toward Gulf of Mexico.

Sheehan Pipe Line Construction Company is constructing 300 miles of gathering lines for Transwestern Pipeline Company. Gathering system will consist of 4, 6 and 8-inch lines in Oklahoma, Texas and New Mexico.

Cia Shell de Venezuela has awarded contract to Brown & Root for construction of 40 miles of crude lines in Lake Maracaibo, Venezuela. The lines include 17 miles of 10-inch and 23 miles of 16-inch.

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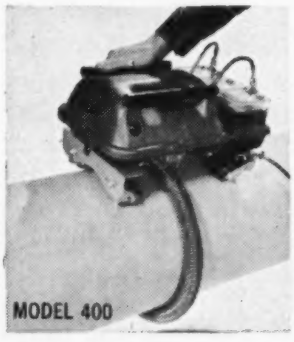
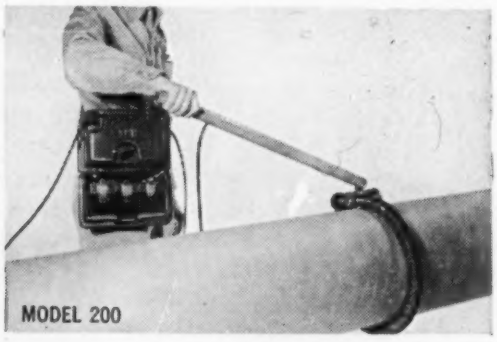

MODEL 400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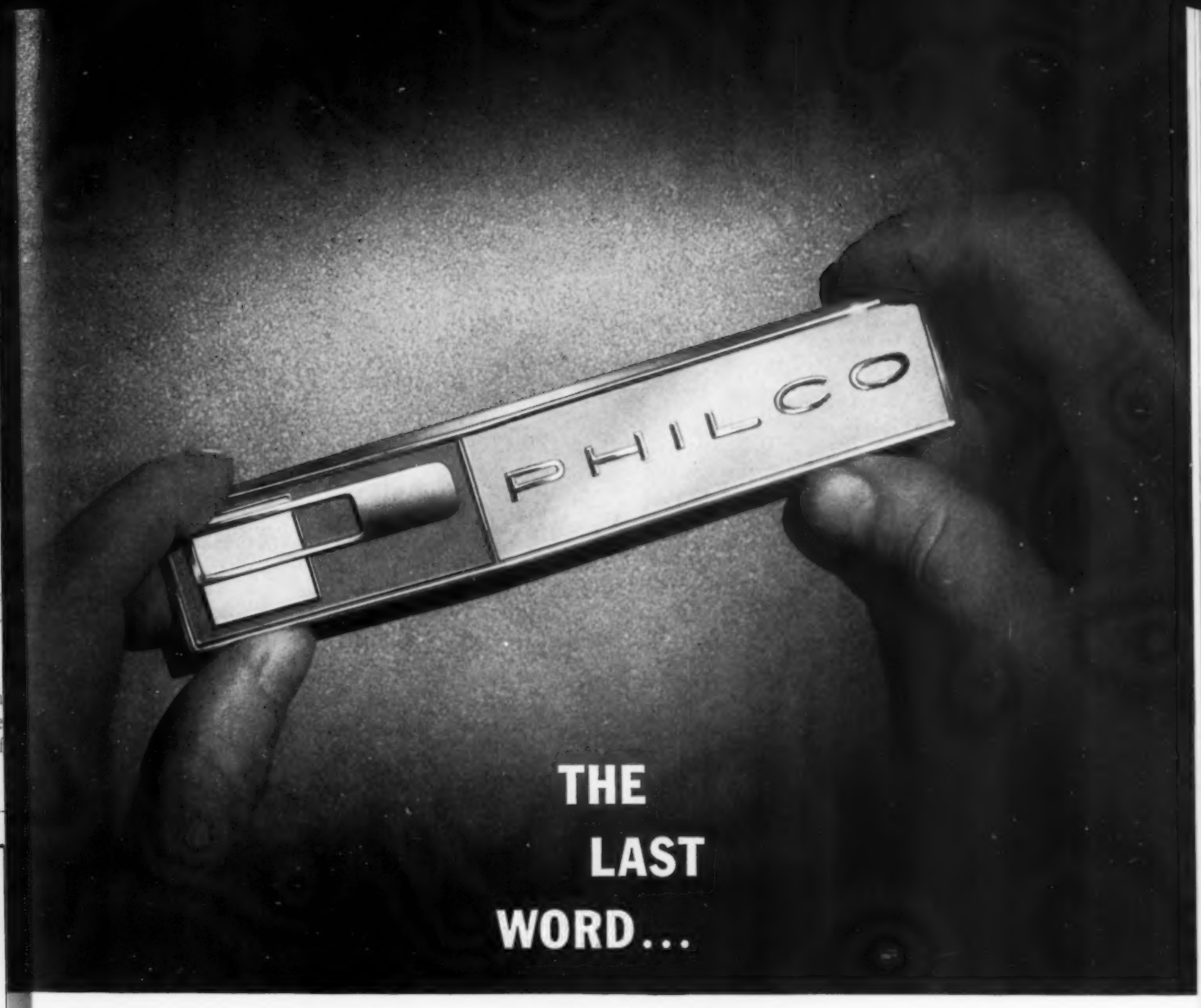

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PROPOSED PIPE LINE CONSTRUCTION

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

U. S.

Alaska Juneau Gold Mining Co., Los Angeles, 425 miles, 16-inch, gas, Oklahoma City area to St. Louis, planned.

Anchorage Gas Corp., Houston, 165 miles, 12-inch, gas, Kenai to Anchorage, Alaska, $15 million, planned.

Arkansas Industrial Pipeline Corp., Shreveport, 130 miles, 18-inch, gas, Perla-to-Helena, Ark., $9 million, planned.

Atlantic Seaboard Corp., Charleston, W. Va., 26-miles, 26 and 20-inch, gas, in West Virginia, Virginia and Maryland, contract let on 19 miles to H. L. Gentry Construction Co.

Carolina Pipeline Co., gas, main line, from near Aiken to Pontiac, S. C., $5 million, approved.

Coastal States Gas Producing Co., Corpus Christi, Texas, 289 miles, 14 and 18-inch main line and gathering system, McAllen to Falfurrias, Tex., area, and Lopena to La Salle County, $12 million, contract let on 200 miles to O. R. Burden Construction Corp.

60 miles, small diameter, gas gathering line, to tie in with system under construction and extend to Pearsall County, Texas, planned.

25 miles, gas, Associated Gas & Oil Co. field to South-Tex Corp., processing plant west of Corpus Christi, Texas, planned.

37 miles, gas gathering in Brown, Eastland, Comanche and Erath counties, Texas, planned.

Coastal Transmission Corp., Houston, compressor station additions and new lateral lines, $6.2 million, before FPC.

Colorado Interstate Gas Co., Colorado Springs, 140 miles, gas, Green River, Wyo.-to-Provo, Utah; 109 miles, 26-inch, Texas Panhandle to southeastern Colorado; 136 miles, 34-inch, southeastern Colorado-to-Pueblo, Colo.; 107 miles, 30-inch, Pueblo-to-Denver, $91 million, before FPC.

Colorado Oil & Gas Corp., Denver, 400-miles, gas, from Gubik field to Fairbanks, Alaska, planned.

Columbia Gulf Transmission Co., Houston, 12.8 miles, 6 and 20-inch, gas, loop line in Louisiana, $730,000, authorized.

East Coast Pipeline Co., 90 miles, 12- to 24-inch, products, Linden, N. J. to Suffolk County, N. Y., $25 million, planned.

El Paso Natural Gas Company, El Paso, 244 miles, 30-inch, Permian-San Juan loops, 108 miles, 20-inch, field feeder lines, before FPC.

69,240 hp in new and existing stations in Texas, Oklahoma, New Mexico and Utah, planned.

400 miles, 34-inch, Salt Lake City, Utah, to California border, before FPC.

Equitable Gas Company, Pittsburgh, Penn., 11.7 miles of storage pipe line and other facilities, $2,091,430, authorized.

12½-miles, 16-inch, paralleling existing system in Harrison and Marion counties, W. Va., authorized.

Florida Pipeline & Storage Co., 54 miles, products, Port Everglades to Homestead Air Force Base, Fla., planned.

Gillette Pipeline Co., Cheyenne, Wyo., 103 miles, crude, from Dead Horse Creek field to Casper, Wyo., planned.

Great Northern Railway, St. Paul, 400-600 miles, 12-20 inch, crude, from Williston Basin to St. Paul-Minneapolis and Duluth-Superior areas, considered.

(Continued on Page 64)

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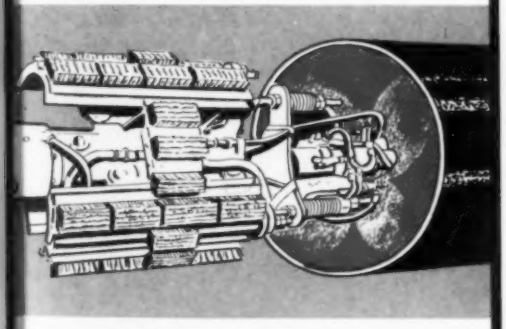
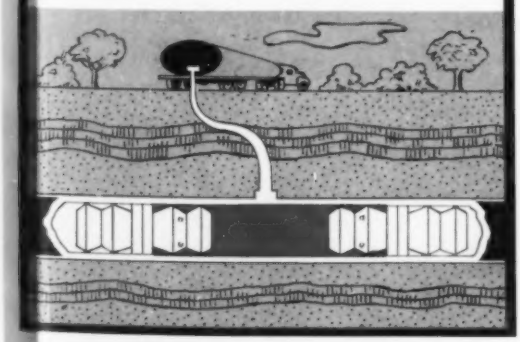


PIPE IN GROUND



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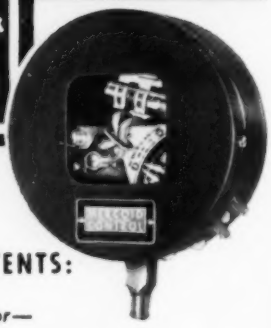

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continued

Gulf Resources, New York, 125 miles, gas, gathering system, from Lopena area in Zapata County to a point in La Salle County, Texas, planned.

Hope Natural Gas Co., Clarksburg, W. Va., 45 miles, gas, from West Virginia to Pittsburgh area, planned, 20 miles, 24-inch, gas, in Wertzel and Monongalia counties, W. Va., authorized.

Humble Oil & Refining Company, Houston, 116 miles, gas, gathering various sizes, southwest Texas, contracts let on 57 miles to O. R. Burden Construction Corp. and H. B. Zachry Co.

Iron Ranges Natural Gas Co., 115 miles, gas, from Itasca and St. Louis counties along route of Mesabi range from Grand Rapids to Aurora, Minn., $5 million, FPC authorization.

60 miles from Duluth to Silver Bay, Minn., FPC authorization.

Kansas-Nebraska Natural Gas Co., 15 miles, 12-inch, gas, loops and 4,800 additional hp at new and existing stations, $1.5 million, FPC authorization.

Michigan Wisconsin Pipe Line Co., Detroit, 311 miles, gas, Marshfield to Appleton, Wis., 66 miles, Illinois, Indiana, and Michigan, 5,280 hp station at Marshfield, $24 million, FPC authorization.

Midwestern Gas Transmission Co., Houston.

504 miles, 24-inch, gas, from Minnesota-Canada border near Winnipeg to Marshfield, Wis., $52 million, FPC authorization.

Missouri-Kansas-Texas Railroad, 1400 miles 8-12 inch LPG line, Midland, Texas, area to St. Paul-Minneapolis, Minn., and Madison, Wis., $55 million, planned.

Natural Gas Pipeline Company, Chicago, 29 miles, 10-inch lateral, in Oklahoma, contract let to R. H. Fulton & Company.

151 miles, 36-inch, gas, loops, between Ford County, Kansas and Joliet, Ill. and 180 miles, 24-inch, main, from Minneola, Kansas to Kiowa County, Okla., $31 million, before FPC.

Northern Natural Gas Company, Omaha.

171 miles, main line extensions, 66 miles, main loops, 139 miles, branch lines, 6,000 hp additions, to extend system from Minneapolis to Duluth-Superior area, $25.7 million, contracts let on 315 miles to Williams Bros. Co. and R. H. Fulton & Co.

46 miles, main line extensions, 191 miles, loops, 1,767 miles, branch lines, and 45,400 additional hp, in Iowa, Minnesota, South Dakota, Nebraska, Wisconsin and Illinois, $76.7 million, FPC authorization.

37 miles, 30-inch, Bushton compressor station to Otis field, Kansas, 7,000 additional hp at Bushton, and development of underground storage facilities at Otis field, $20 million, before FPC.

Ohio Fuel Gas Co., 59 miles, gas, 4-24-inch main lines, in Belmont, Carroll, Cuyahoga, Fairfield, Logan, Lorain, Marion, Muskingum, Stark and Wayne counties, Ohio, $5.1 million, planned.

Pacific Gas & Electric Co., San Francisco, 296 miles, 36-inch, gas, from Klamath Falls, Ore., to Antioch, Calif., southern section of line from Canada to California, before California Public Utilities Commission.

131 miles, 34-inch, loops, Topock-Milpitas, before FPC.

42 miles, 30-inch, gas, Pittsburg to Irvington, Calif., planned.

Pacific Gas Transmission Co., San Francisco, 614 miles, 36-inch, Kingsgate B.C. to Klamath, Ore., northern section of Canada to California line, before FPC.

Pacific Lighting Gas Supply Co., 128-mile, 34-inch, gas, main line from Topock, Ariz. to Newberry, Calif., contract let to Pacific Pipeline Construction Co.

Pacific Northwest Pipeline Corp., Salt Lake City, 100 miles gas, gathering lines in San Juan Basin, Garmesa, Piceance Creek, and Big Piney Fields, $3.5 million, planned.

59 miles, 16 and 20-inch, gas, from a point on main line near Camas, Wash., to Salem, Ore., $6.1 million, before FPC.

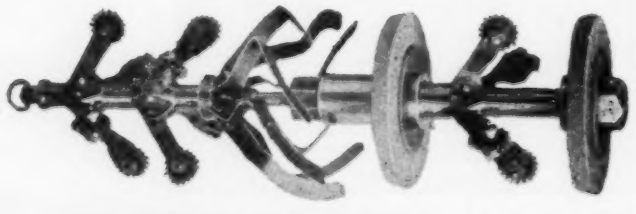
Permian Basin Pipeline Company, Omaha, 83 miles, 16-inch, gas, from Pioneer's proposed facilities to Spraberry, Texas, and 3,960 hp compressor station, $5 million, FPC examiner approval.

(Continued on Page 66)

Go-Devil

NORTHRUP GO-DEVILS

Heavy Duty Model with Neoprene cup or disc drivers



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PIPELINE CONSTRUCTION IN ENGLAND AND SCOTLAND is moving briskly ahead, paced by reliable, fast-digging Cleveland trenchers. The job photos reproduced here show Clevelands at work on: a 32-mile 12-inch line for the Scottish Gas Board; a 15½-mile 24-inch line for the North Thames Gas Board; a 13½-mile 16-inch line for the Southern Gas Board; a 23-mile 6 and 8-inch line for the Eastern Gas Board. A Cleveland will dig it better—anywhere.

Good Everywhere

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PROPOSED CONSTRUCTION
continued

Pioneer Natural Gas Co., Amarillo, Texas, 62 miles, 10-inch main, Pampa, Texas, to Canyon, in Randall County, Texas, 20 miles, small diameter, gathering, 4,000 h.p. stations, $4.5 million, planned.

Phillips Petroleum Co., 25 miles, 6 to 20-inch, gas, South Eunice, New Mexico area, planned.

52 miles, 4 to 20-inch, gas, Gaines County, Texas, planned.

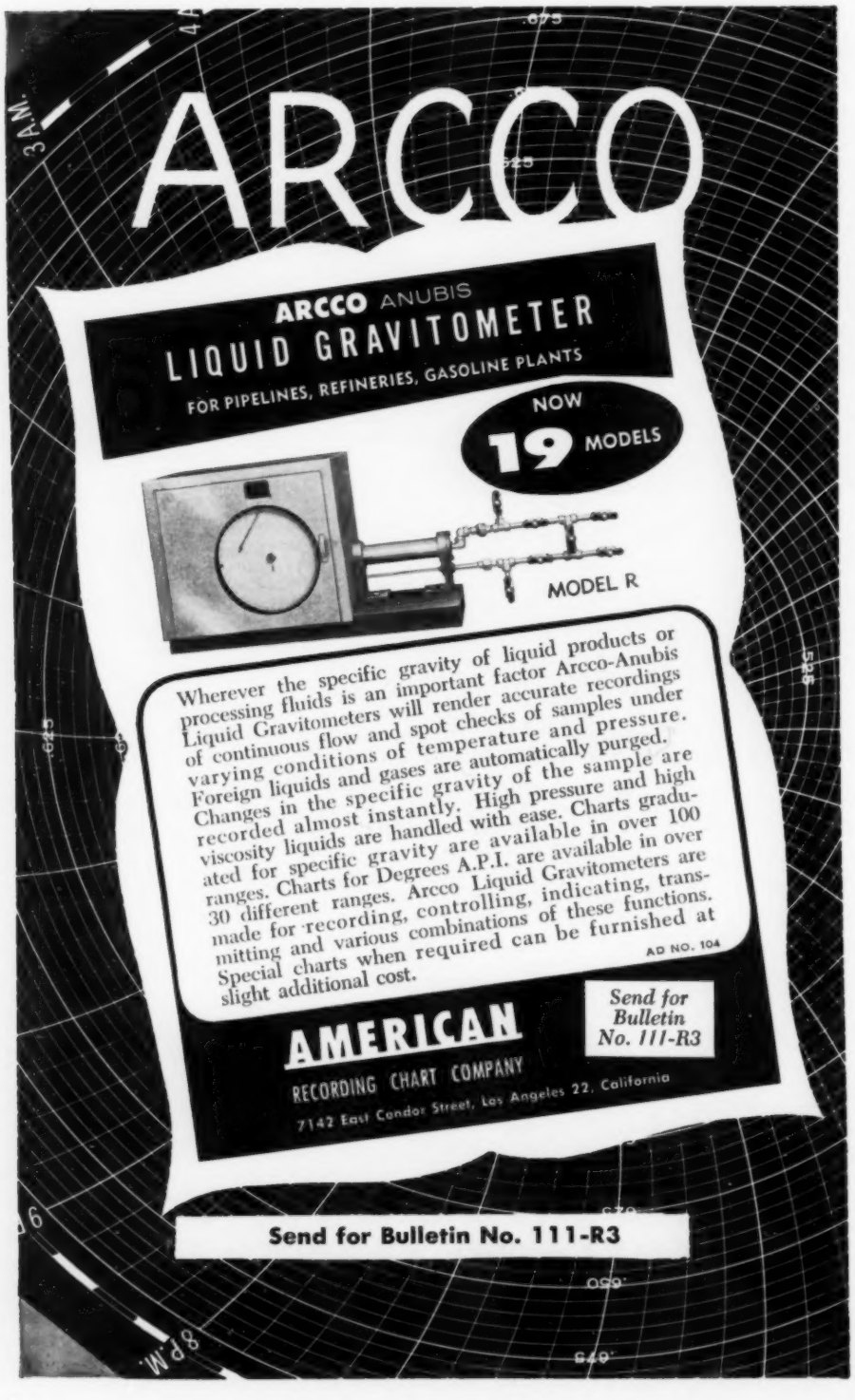
44-mile, 6-inch, products line, from Rocky pump stations to Amarillo, Texas, planned.

Rio Gas Gathering Co., San Antonio, 97 miles, 3 to 8-inch, gas gathering, South Texas, to supply gas to El Paso Natural Gas Company, planned.

Rocky Mountain Natural Gas Company, 65 miles, gas, southwestern Colorado to serve Delta, Orchard City and Montrose, Colo., planned.

Shamrock Oil & Gas Company, 49 miles, 20-inch, gas, Dumas to Amarillo, Texas, planned.

Southern California and Southern Counties Gas Cos., Los Angeles, 200 miles, 34-inch, from Nevada-California border to point near Fullerton, Calif., $44 million, before Public Utilities Commission.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Southern Natural Gas Company, Birmingham, 490 miles, 16-24-inch, loop lines, gas, between Gwinville, Miss., and Wrens Ga; 62 miles, 14-inch, loops, along Atlanta-Macon line; 53 miles, 6⅝ to 14-inch, loops, along various branch lines. 3,140 additional hp at Gallion and Elmore, Ala. and Wrens, Ga. 60 miles, 20-inch, loops, in Louisiana between Franklinton and White Castle and South of Toca. Lateral lines south of Gwinville and west to Cranfield field. 8,720 hp added at Franklinton, White Castle, Patterson and Brookhaven, contracts let on 442 miles to Sharman, Allen, Gay & Taylor; Oklahoma Contracting Co. Harbert Construction Corp.; C. S. LeNoir Construction Co.; and Buchanan Contracting Co.

Standard Oil Company of California, 22 miles, 8-inch, crude, Kenai Peninsula to Nikiski, Alaska, $4 million, considered.

Tennessee Gas Pipeline Co., Houston, 21 miles, 16-inch, 2 miles, 12¾-inch, gas, Louisiana coast, Vermillion, Blocks 46 and 64, $2.9 million, before FPC.

158 miles, 36-inch, looping system in Louisiana and Mississippi, to supply Midwestern additional gas at Portland, Tenn., $61.4 million, authorized.

Texas Eastern Transmission Corp., Shreveport, La.

65 miles, gas, Delmont, Penn., to Lambertville, N. J., before FPC.

40 miles, Lambertvile to Linden, N. J., before FPC.

350 miles, 24-inch, coal slurry, West Virginia to New York, considered.

Texas Electric Service Company, Fort Worth, 300 miles, gas, Old Ocean field to Fort Worth, Texas, $25 million, considered.

Tensas Gas Gathering Corp., Shreveport, 36.6 miles, gas, gathering system in Rodney Field, Jefferson County, Miss. and from North and South Locust Ridge, Lake St. John Field in Tensas and Concordia parishes, La., $855,413, authorized.

Texas Illinois Gas Pipeline Company, Chicago, 16,000 additional hp to stations at Lufkin, and Marshall, Texas; Texarkana, Malvern, Searcy, and Biggers, Ark.; Jackson, Mo.; and Hammond. Ill., $3.9 million, FPC authorization.

371 miles, 30-inch, loops, and 45 miles, laterals, gas, 6,700 hp station in Victoria County, Texas, $43.5 million, before FPC.

Transcontinental Gas Pipe Line Corporation, Houston, 129 miles, 30 and 36-inch loops; 53 miles of laterals, and additional horsepower capacity, in Texas, Louisiana, Alabama, Georgia, North Carolina, Virginia, Pennsylvania and New Jersey, $53 million, FPC examiner approval.

211 miles, 36-inch, and 69 miles, 30-inch, loops and additional 32,040 hp, in Texas, Louisiana, Mississippi, Alabama, Georgia and South Carolina, $52 million, before FPC.

(Continued on Page 68)

How to make tracks at pig-running time!

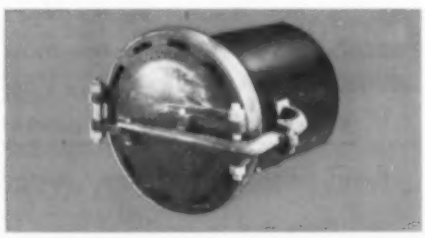
Unibolt hinged scraper traps are the answer

But not even a Unibolt Scraper Trap . . . with its easy-opening two-bolt coupling, its free-swinging hinged closure, its tight-sealing, long-lasting resilient gasket . . . can take all the work out of catching a pig. It comes mighty close, though, to making the job of starting and catching scrapers a trouble-free operation.

Unibolt originated the hinged closure to eliminate the troublesome, time-consuming multi-bolt blind flange. And the Unibolt self-sealing resilient gasket that remains in place when the closure is opened seldom, if ever, needs replacing. This saves you money as well as time. And a Unibolt Scraper Trap installed on an oversize barrel, the i.d. of which is slightly larger than the o.d. of the line, eliminates "fighting" the pig in and out of the trap. Line pressure does the heavy work.

The Unibolt Hinged Blowdown, or blowoff head, is an ideal companion to the Unibolt Scraper Trap on gas line service.

Complete details are carried in Bulletin PL-590, copies of which will gladly be sent on request.



A hinged type Unibolt Scraper Trap in closed position.

UNIBOLT

THORNHILL CRAVER CO.

P. O. Box 1184, Houston, Texas

PROPOSED CONSTRUCTION

continued

13 miles, 24-inch and 18 miles, 20-inch loops, Louisiana, FPC authorization. 14 miles, 16-inch laterals, 1-mile, 12-inch lateral, Louisiana, $2.1 million, FPC authorization.

29 miles, 20-inch, gas, and 2,500 hp, in South Texas to take gas from South Texas Natural Gas Gathering Co., $2.4 million, before FPC.

Transwestern Pipeline Company, Houston, pipe line facilities to cost $5.4 million to make available additional gas reserves for the line presently under construction, before FPC.

Underground Storage & Exploration, Upper Darby, Penn., 394 miles, 12-inch LPG, from Moundsville, W. Va. to Newark, N. J., $9 million, approved.

95 miles, 6-8 inch, laterals to Mauch Chunk, Penn., and to Philadelphia, planned.

Valley Gas Transmission, Inc., Houston, 55 miles, 3 to 8-inch, gas, gathering, in Hidalgo, Brooks, Starr and Jim Wells Counties, Texas, $15 million, before FPC.

Wilcox Crude Oil Corp., Shreveport, La., 20 miles, crude line in east central Louisiana, $500,000, planned.

International

ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., to Bella Coola, B. C., before B. C. government.

Alaska-Yukon Refiners and Distributors, Ltd., Edmonton, Alta., 150 miles, products, serving Alaska and Yukon territory, $3.5 million, planned.

Alberta Gas Trunk Line Company, 386 miles, 26-36-inch, gas, main, Berland River area, Alberta, to Alberta-British Columbia border; and 235 miles, 8-18-inch, gas, gathering, Alberta, $100 million, Alberta Oil and Gas Conservation Board, approved.

Alberta Natural Gas Company (Jointly owned by Westcoast Transmission Co. and Alberta & Southern Gas Co. Ltd.) 110 miles, 36-inch, gas, Alberta border to British Columbia-Idaho border, supply gas to Pacific Gas & Electric Co., $40 million, planned.

Arab League Oil Committee, large diameter crude line from Persian Gulf to Mediterranean Coast, $500 million, considered.

Aurine Alps Railway & Pipeline, 200 miles, crude, Venice to Munich, Germany, considered.

Bituminous Oil Pipeline Co., Calgary, 250 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, approved.

Burmah Oil Co., Ltd., 850 miles, crude, 20 inch, from Nahorkatiya to Calcutta, India.

Cartier Gas Corp. (St. Maurice Gas, Inc., and Consumers Gas Co., Toronto), 170 miles, gas, Montreal to Quebec City, planned.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Creole Petroleum Co., 44 miles, 12-30-inch, gas, Bachaquero to Tia Juana, Venezuela, planned.

Development and Resources Corp., 70 miles, 8 inch, gas, from Agha Jari oil field to Ahwaz, Iran, planned.

Entre Nazionali Idrocarburi, Rome, Italy, crude, from Qum field in Iran to the Mediterranean Sea, considered.

Foothills Pipe Line, Ltd., 500 miles, 12 to 16-inch, LPG, from Alberta to Pacific Coast, $80 million, considered.

Gibson Crude Oil Purchasing Co. Ltd., 170 miles, crude, Milligan Creek, B. C. to Grande Prairie, Alta., planned.

Hydrocarbons Pipeline, Ltd., Winnipeg, Manitoba, 880 miles, 6-8 inch, products, from Edmonton to Winnipeg, $35 million, partial authorization.

Independent Pipe Line Co., 2,019 miles, 34-36-inch, crude, Edmonton to Montreal, 23,000 pump horsepower, $395 million, before Borden Commission.

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Photos courtesy of Southern California and Southern Counties Gas Companies

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Interprovincial Pipe Line Company, 350-mile extension from Toronto to Montreal, looping line from Edmonton to Toronto, crude, $240 million, considered.

Additional horsepower in four new stations and several existing stations, $9.3 million, planned.

Island Transmission Company Limited, Nanaimo, B.C., 25 miles, 10-inch, gas, from point near Vancouver, B.C. to Vancouver Island, 67 miles, 10-inch, laterals to Victoria and Nanaimo, B.C., $14 million, planned.

Mid-Continent Pipe Lines, Ltd., 1500-mile, 30-inch crude, Edmonton to Chicago, planned.

National Iranian Oil Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

1000 miles, 38 inch, crude, from central Iran to the Turkish Mediterranean coast, considered.

500 miles, 8-inch, products, Teheran to Meshed, Iran, contract let on 250 miles to Williams Bros. Co.

Pacific Petroleums Ltd., 213 miles, 3-8-inch, crude, gathering, Milligan Creek and Blueberry fields to Dawson Creek, planned.

Palestine Economic Corp., New York, 135 miles, 16-inch, crude, Eilat to Beersheba, Israel, to be completed July 1960.

Peace River Oil Pipe Line Co., Ltd., 70-mile, crude, Swan Hills to Iosegun Junction, approved.

230 miles, 8-inch, crude gathering, from fields in northeast British Columbia to Dawson Creek, B. C., and Grande Prairie, Alta., and to existing lines at Sturgeon Lake, $8.5 million, authorized.

Pembina Pipe Line, Ltd., Edmonton, 1,200 miles, LPG, from Alberta gas fields to eastern Canada, planned.

Petroleos Mexicanos, 38 miles, 4 inch, products, from Mexico City to Toluca, $500,000 planned.

126 miles, 4, 6 and 8 inch, products, from Mexico City to Cuernavaca and Puebla, $2.5 million, planned.

214 miles, products, Monterrey to Torreon, $6.5 million, planned.

Pipelines of Puerto Rico, Inc., 95 miles, 8-inch, products, Penuelas to San Juan, Puerto Rico, planned.

Rangeland Pipe Line Company Limited, 111 miles, 8-inch, crude, southeastern Alberta to Calgary, $3 million, planned.

Sociedad Nacional de Oleoductor, 75 miles, crude, from Santiago-to-Valparaiso, $3 million, planned.

Societa Nazionale Metanodotti, 650 miles, 18-inch, crude, Genoa, to Milan-Cremona-Torino, Italy, and Aigle, Switzerland, with extensions to Karlsruhe and Munich, Germany, planned.

Societe d'Etude du Pipe Line Sud-European, Paris, 419 miles, 30-inch, crude, port of Lavera to Strasbourg, with lateral extending 40 miles to Karlsruhe, Germany, approved by French cabinet.

Standard-Vacuum Oil Company, 60 miles, 8-inch, gas, main, in South Sumatra, considered.

Ste. d-Etudes de Pipeline Intercontinetaux, Paris, 1,400 miles, 30-40-inch, gas, from Hassi R'Mel field in central Algeria across Mediterranean, through Spain, France and into West Germany, considered, Fish International Corporation making engineering and feasibility studies.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

130 miles, 16-inch, gas, main line, Multan to Lyallpur, planned.

Trans-Canada Pipe Lines Limited, Toronto, 50-mile, 30-inch, gas, lateral, Winnipeg to Emerson, Manitoba; 74 miles, 34-inch, loops, additional compressor hp at Swift Current, and Indian Head, Saskatchewan, and Portage la Prairie, Manitoba, $45 million, planned.

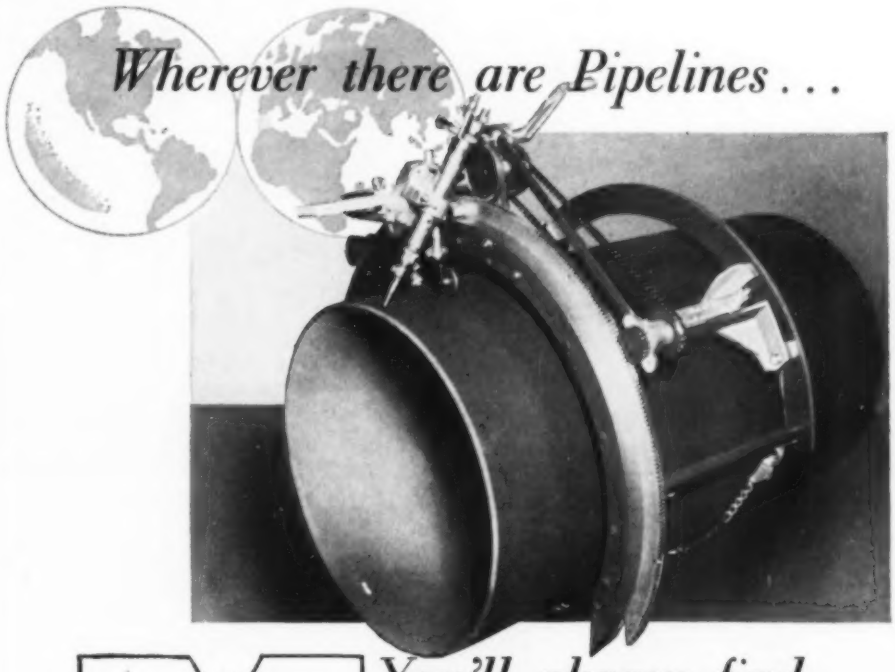
268 miles, 34-inch, loops, and additional hp planned for 1961, $69 million.

122 miles, 34-inch, loops, hp additions, $46 million, planned for 1962.

Trans-Prairie Pipelines, Ltd., Edmonton, crude line, from Weyburn field to Re-

(Continued on Page 70)

Wherever there are Pipelines . . .



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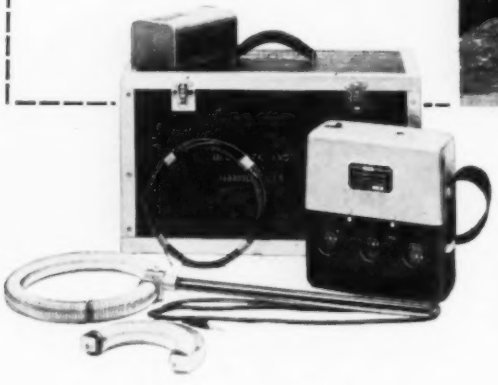

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PROPOSED CONSTRUCTION

continued

gina-Moose Jaw areas, $5 million, considered.

Crude line from Milligan Creek area to Dawson Creek and Fort St. John refineries, planned.

Union Gas Company of Canada Limited, 45 miles, 8-inch, gas, main, Stratford to Goderich, Ontario; 10-miles, 8-inch, main, to Amhertburg; 10-miles, 12-inch, lateral, Galt to Brantford, planned.

Westcoast Transmission Company, Ltd., 250 miles, 30-inch, gas, Taylor to Fort Nelson, B. C., planned.

Williams-McWilliams Industries, Inc., New York, 441 miles, 6-inch, crude, Villa Montes, Bolivia to Villa Hayes, Paraguay, considered.

Yacimientos Petroliferos Fiscales, Buenos Aires, Argentina, 621 miles, 12-inch, products, Mendoza to San Lorenzo, Argentina, $19 million, planned.

281 miles, 12¾ inch, crude, Pichanal to San Miguel Tucuman to Techint, S. A., planned.

450 miles, 16-inch, crude, from Neuquen Province to Bahia Blanca, planned.

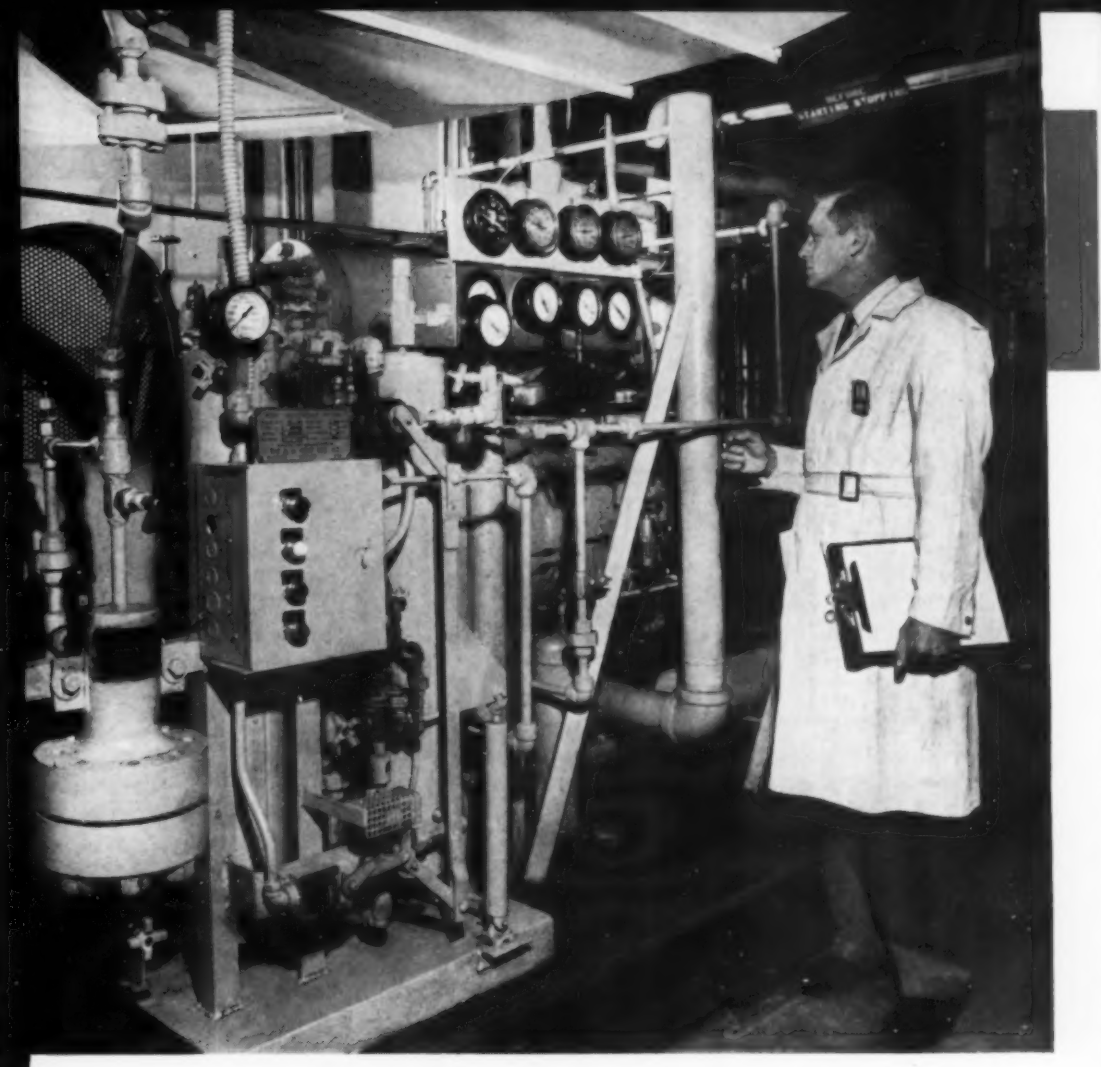
Transwestern Seeks Approval To Expand Pipe Line System

Transwestern Pipeline Company is seeking Federal Power Commission approval for construction of additional facilities to its system presently under construction.

The new facilities are to make available over one-half trillion cubic feet of additional gas reserves for Transwestern. Transwestern is requesting an early decision on the $5.8 million project in order that they may be built during initial construction of the line.

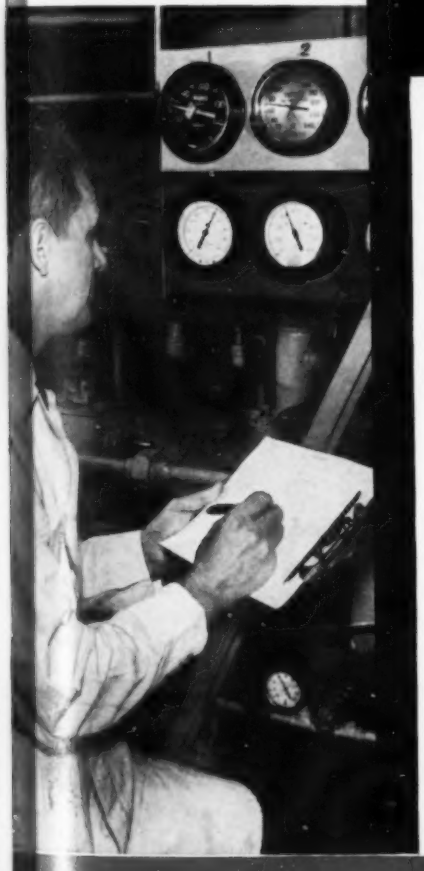
Proceedings Reopened In CATCO Sales Case

The Federal Power Commission has ordered hearings to begin January 12 on reopened proceedings involving large offshore gas sales by CATCO to Tennessee Gas Transmission Company. Proposed sale price for the Louisiana offshore gas is 21.4 cents per Mcf plus 1-cent state tax. Proceedings were reopened to enable producers "to adduce such additional evidence as they may deem necessary or appropriate to support or justify the initial prices there proposed in accordance with the opinion and judgment of the Supreme Court of the United States."



Right
Four-stage air compressor in operation at Hamilton Standard Division of United Aircraft, Windsor Locks, Connecticut. Fire resistant Celanese Cellulubes materially reduced downtime and maintenance costs.

Below
Mr. Robert Fredrickson, Foreman, checks compressor operation.



Air cost extra thousands...

until Hamilton Standard switched to Cellulubes

At Hamilton Standard, lubrication of a 4200 psi four-stage compressor was a serious problem. Carbon deposits from petroleum lubricants made it necessary to lease a stand-by compressor, and a mechanic was assigned to round-the-clock duty to prevent valve malfunction and spring breakage. Even so, repair bills and maintenance costs ran into large sums of money, and valuable production time was lost. After switching to Cellulube 220, only routine maintenance was required. The formation of petroleum carbon residues ceased, and oil fouling of the compressed air dryer was eliminated. The former constant threat of fire and explosion was also eliminated. Cellulubes made it possible to ship back the stand-by compressor and turn over servicing of the machine to its regular department.

Cellulubes are more than a means of increasing safety. These synthetic lubricants have a cleansing action inside machinery. They give overall wear protection comparable to that of premium petroleum oils. Write for information on how Cellulubes can help you achieve greater efficiency and safety in your plant.

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Celanese CHEMICALS

ON THE LINE

Training Program for Supervisors

Southern Union Gas Company has come up with a new idea for training construction and maintenance supervisors and foremen. The gas company held the first of a series of five-day classes in Dallas the week of November 30.

Porter W. Martin was responsible for compiling a text book for the course from a collection of the best methods used in construction and maintenance. This manual contains general information on history of natural gas, and discussions on pressure, specific gravity, heat and application of absolute units. Other sections of the book are concerned with study of instruments, customer relations, safety and legal responsibilities.

Construction procedures and practices are outlined; this includes pressure testing, hauling and stringing, purging, cathodic protection, tamping, standard code, inspection and welding methods.

Southern Union expects the programs to produce maintenance and construction personnel better equipped to follow phases of company's operations.

Technical Writers' Institute

The eighth annual technical writers' institute is scheduled for June 13-17 at the Rensselaer Polytechnic Institute, Troy, N. Y.

The school will be directed by Professor Jay R. Gould and present lectures by industrial speakers on editing, writing and supervision of publications.

The writers' institute at Rensselaer was started in 1953 to provide a forum and workshop for writers and editors. Over 500 representatives from 250 industrial firms, government agencies and technical publishing companies have attended the week-long seminar.

Inquiries should be sent to Professor Jay R. Gould, Director, Technical Writers' Institute, Troy, N. Y.

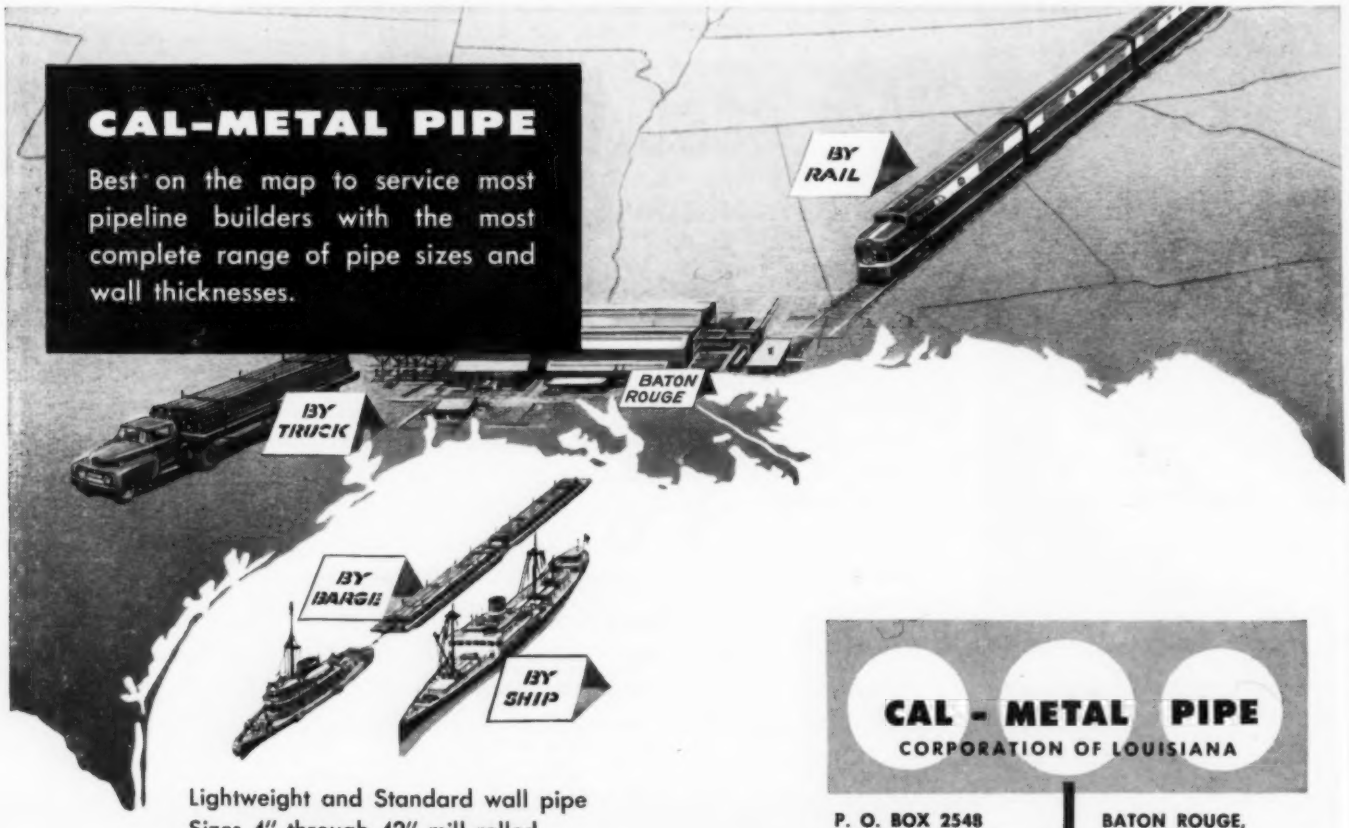
Houston NACE Short Course

The Houston Section of the NACE announces a change in dates and meeting place for its annual two-day course in practical corrosion control systems. Originally scheduled for January 22-23 at the University of Houston, the conference will be held at the Rice Hotel, January 28-29.

Recommended for superintendents, foremen, operators, engineers, technicians, inspectors, architects and sales personnel, the meeting will concentrate on corrosion practical aspects.

First day will be devoted to fundamentals and general principles; second day will expand on principles with individual, separate, full-day sessions on pipe lines, oil & gas production, utilities and refineries.

Ben Russell, Rio Engineering Co., P. O. Box 6035, Houston 6, is in charge of registration; fee is $20.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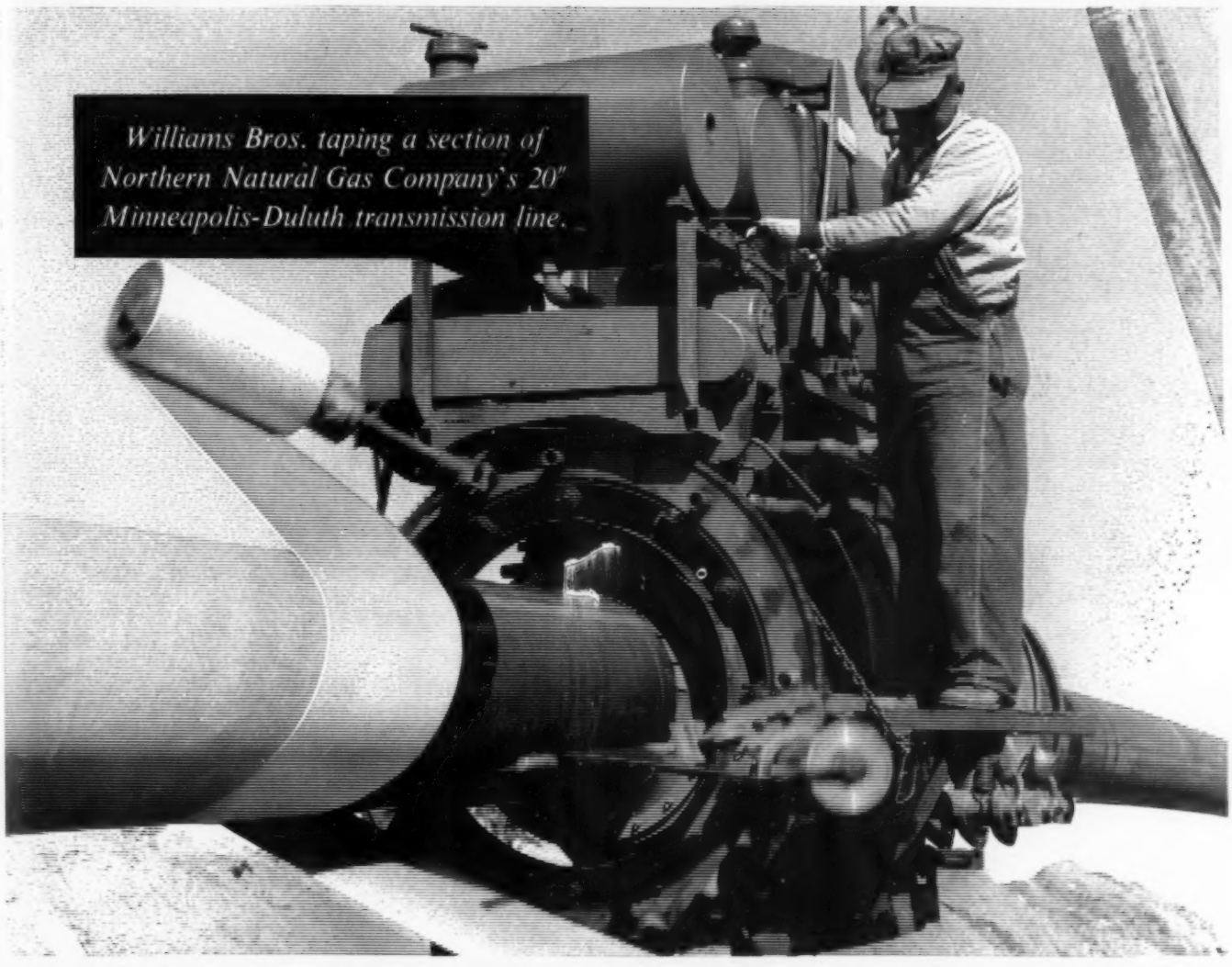

Williams Bros. taping a section of Northern Natural Gas Company's 20" Minneapolis-Duluth transmission line.

POLYETHYLENE TAPE by SEAMLESS

used for coating 53 miles of 20" main line in Northern Minnesota

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Here are the results...

- Actual construction time, 31 days.
- Reduction in construction costs.
- Less equipment required.
- Despite numerous swamps and peat bogs, the tape crew averaged approximately 9,000 feet per day.

Whether for main-line construction or an accessory application, Seamless has a specific tape for your installation. Write for field specifications and particulars.

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THE SEAMLESS RUBBER COMPANY

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A SUBSIDIARY OF THE REXALL DRUG & CHEMICAL COMPANY

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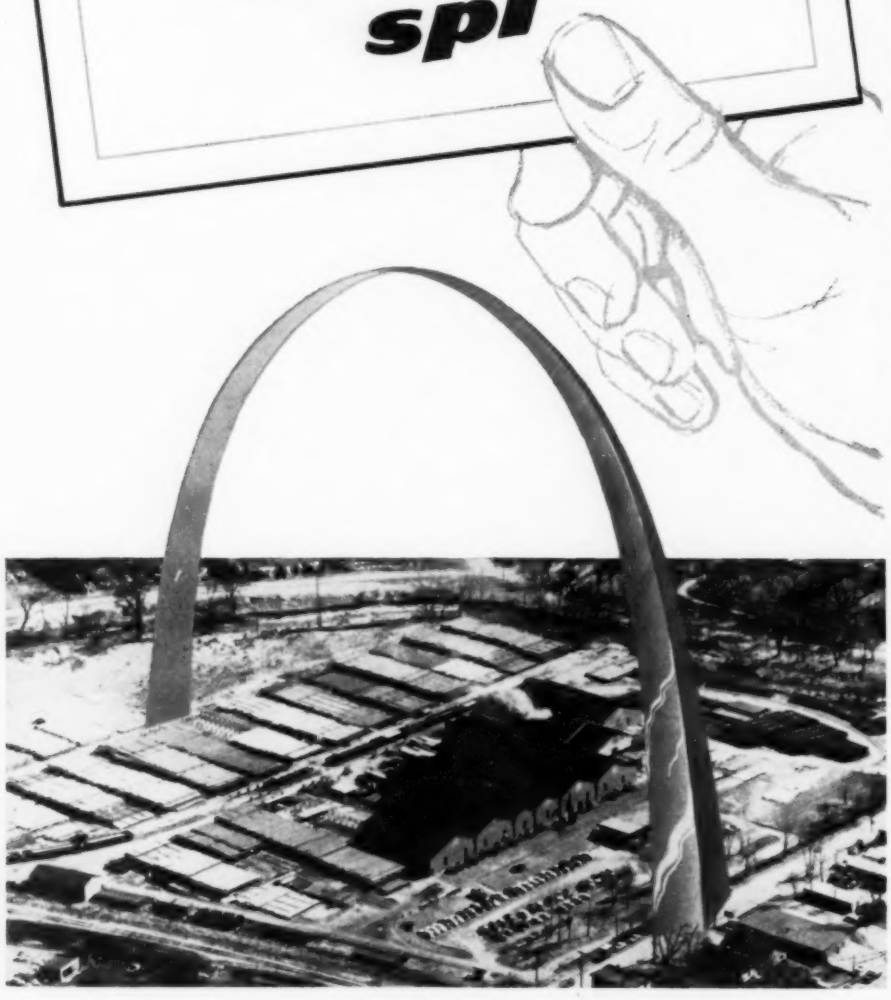

This is an invitation to all oil men, gas men, contractors and utility men to visit our plant in St. Louis at any time. We will be happy to let you look under our roof . . . to conduct you on a tour of our plant to show you our operations.

Our Standard Procedures establish the highest standards of quality for coated and wrapped pipe. See for yourself that every claim we make is a fact.

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New Pipe Liners Club Formed

The Edmonton Pipe Liners Club has expanded into the Pipe Liners Club of Western Canada. The Edmonton organization was founded in 1958 with 47 members attending the inaugural meeting; the new club has an enrollment of 101 engineers, operators, technicians, accountants, landmen and executives from 22 companies.

G. J. Evans, newly elected president, outlines the objectives of the club as a medium where members in oil and gas pipe line industry, may exchange ideas and become better acquainted.

"Future Bright for Rubber Industry"

Harvey S. Firestone, Jr., commenting on new decade beginning this year says, "the rubber industry will enter the 'Soaring Sixties' in a strong, healthy condition and with a very bright future."

Discussing the current year Firestone predicted, "The year 1960 should be the greatest year in the history of our progressive industry." While the major influence on the rubber industry will be the great growth in automotive industry, consumption is on the increase for all rubber and rubber-like products.

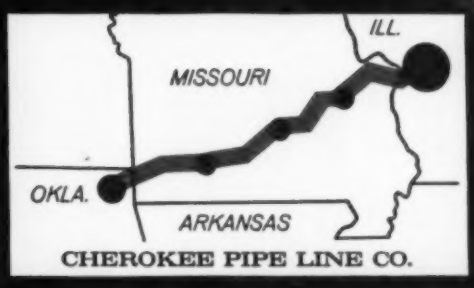
"Invest in America Week"

Gardiner Symonds, board chairman and president of Tennessee Gas Transmission Company, has been named national chairman of 1960 Invest-in-America Week.

To be observed April 24 through April 30, this program is designed to help people understand more clearly why they are living better than ever before. "Nearly every American is a direct or indirect investor in the economy through ownership of a home, insurance, savings account or securities," Symonds said. "Money at work means men at work, and for every job in America an average of $17,000 must be invested in buildings, tools, power and all the other things that make that job possible," he explained. As chairman for 1960, Symonds' goal is to enlist cooperation of all segments of industry, labor, agriculture, commerce and finance in observance of 1960 Invest-in-America Week.

Now with Christmas shopping completed—invest.

PUSH BUTTON PIPELINE



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ANOTHER first from SIE *and Dresser!*

Write Rex Grey for your personal copy of . . .

"Control . . . the answer to increased pipe line profits"

SIE, through solid state electronics brings you the latest developments in remote supervision, computing and control.

- Automatic Sequencing and Load Control
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Designed for long life and reliability with highest data density and scan rate of any system . . . by

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What's Happening among MEN in the INDUSTRY

Donovan C. Wise

Sidney S. Galpin

New York State Natural Gas Corporation announces appointments of **Donovan C. Wise** manager, operating plans and budget and **Sidney S. Galpin** division superintendent for the company's Southern Division.

Wise joined the **Peoples Natural Gas Company** in 1939 and was transferred to New York Natural in 1951. He was promoted to Southern Division superintendent in 1957. He will assist the company management by administering the planning and budget program. Galpin has been with the Peoples Natural Gas organization since 1937. In 1952 he was transferred to New York State as assistant superintendent and production engineer of the Oakford District. He was named production engineer Central Division in 1957.

Texas Eastern Transmission Corporation announces several personnel changes at its products terminals. **Carl E. Shirron** becomes foreman at Helena, Ark., and **Lloyd Clinton Roberts** replaces him as foreman at Baytown, Texas. **George Albert Neuser, Jr.,** was promoted from control point to take over Roberts' position as assistant foreman at Beaumont, Texas.

Shirron has been with the company since 1954 and he was named terminal foreman at Baytown in 1957. Shirron had been with Triangle Pipeline Company which was purchased by Texas Eastern in 1954. Roberts also had been with Triangle since 1950. He was promoted to assistant foreman at Beaumont terminal in 1957. Neuser joined Texas Eastern in 1958 as control point operator. Previously he had been with Sinclair Pipeline Company, Crown Central Petroleum Corporation and Southern Pacific Pipe Lines, Inc.

Texas Gas Corporation announces the appointments of two new staff members. **Pat H. Cain** becomes a reserve engineer and **William C. Cooley, Jr.,** a geologist with the company.

Before joining Texas Gas Corporation, Cain had worked with Standard Oil of Texas, Tennessee Gas Transmission Company, H. Zinder and Associates, Halliburton and the International Petroleum Company of Columbia. Cooley had been with Gulf Oil Corporation before joining the company.

James C. Dotson, former district superintendent at Lovington, N.M., for **Service Pipe Line Company,** has been transferred to Casper, Wyo. Dotson replaces **John H. Keyes, Jr.,** who has been named manager of the **Bayou Pipe Line.** Dotson will supervise operations of lines that run from the Elk Basin, Pilot Butte, Beaver Creek, Sussex and Salt Creek fields into the Casper area then on east to Fort Laramie.

Howard Keir has been appointed plant superintendent of **Southern Counties Gas Company's** pipe line district, headquartered in Ventura, Calif. Keir replaces the late **T. C. Wallace.** He formerly had been assistant plant superintendent at the gas company installation. He has been with the company since 1927.

Texas Gas Transmission Corporation announces the appointment of **J. W. Carneal** as executive assistant to the vice president in charge of employe relations and land and lease.

J. W. Carneal

He will continue his responsibilities in the industrial development activities. Carneal has been with Texas Gas since 1949 and has served the company as a soil technologist in the pipe line department, chief soil conservationist, manager of company housing, assistant superintendent of pipe line department, industrial representative and assistant director of sales and customer relations.

Northern Natural Gas Company has appointed **Albert T. C. Rutgers** gas supply and reserves representative for Western Canada. He will succeed **W. E. Ainsworth** as head of the Calgary offices. Ainsworth has returned to the company's main office in Omaha, Neb.

Rutgers had been a senior reservoir geologist for Pacific Petroleums, Ltd., for seven years prior to joining Northern. He also has worked as a geologist in the Middle East and North Africa.

William Oppel, Jr., has been named manager of industrial relations for Mid-Valley, Inc. Oppel will replace **E. D. Hoekstra** who resigned to become affiliated with the National Constructors Association. Oppel will have charge of Mid-Valley's labor relations and he will also carry out its public relations program.

Henderson Supplee, Jr., president of **The Atlantic Refining Co.,** was elected API vice president for transportation at the Institute's 39th annual meeting.

PLICOFLEX

PLANT IN HOUSTON INCREASES OUTPUT OF

THE BETTER TAPE COATING

Plicoflex, the line proved protective tape coating, combines butyl rubber and polyvinyl chloride to give these important advantages:

1. *Shock Impact Resistance*
2. *Moisture Migration Proof*
3. *Built-in Color Coding*
4. *Economical Installation*
5. *Permanent Bond*
6. *Fungus Proof*

PLICOFLEX TRADE MARK

The outer layer which is of vinyl now contains flame resistant chemicals. It provides strength, toughness, abrasion resistance, and permanence. With the butyl side applied against the primed surface, crevices and scratches are filled, leaving no gaps between tape and pipe.

Available in 10 colors Plicoflex tape coating (No. 340) comes in widths from 1 to 18 inches and in thicknesses from 15 to 35 mils. *Write for folder giving complete technical details.*

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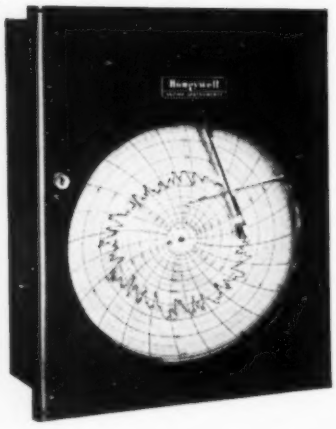
Efficient new Houston plant facilities give you improved quality tape at reduced prices.

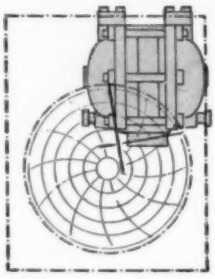
Honeywell Bellows Flow Meter

HERE ARE FOUR OF MANY WAYS YOU CAN USE THE BELLOWS FLOW METER



For direct measurement and control

the meter is integrally mounted on indicators, indicating controllers, recorders, or recording controllers.



▲

With an indicator or recorder—Indicators can be supplied with or without pneumatic transmission. Recorders can be one, two or three-pen instruments, with the second and third pens actuated by thermometer and/or pressure elements.

▲

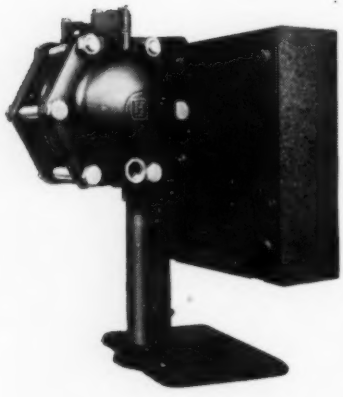
With indicating or recording controllers—All indicators and recorders can be supplied with any pneumatic control form from on-off to three-mode. Indicating controllers are also available with pneumatic transmission.

With a "blind" transmitter—the non-indicating differential pressure transmitter is used when indication is not required at the process and the variable is to be transmitted to remotely located instruments.

▼

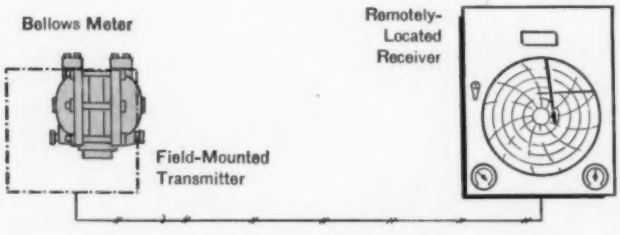
With an indicating transmitter—Scale is graduated in accordance with the flow or liquid level span of the transmitter. These transmitters are available with pneumatic control to remotely operate final control elements.

▼



For remote measurement and control

Field-mounted transmitters, either "blind" or indicating, can be used with remotely located indicators, recorders, and controllers.



and with Tel-O-Set miniature instruments and a variety of options!

has applications unlimited

Unequaled for accuracy, stability, versatility in flow and liquid level metering

Here's the most advanced meter body available today, with advantages never before found in flow and liquid level meters. Combine the new Honeywell Bellows Flow Meter with the instruments shown on the facing page for truly superior service in metering steam, water, gas, oil and other fluids.

Some of its outstanding features:

Sensitive and accurate—Sensitive to within 0.05% of full scale . . . calibrated accuracy ± 0.5% of full scale.

Leakproof—Between liquid fill and process fluid.

Automatically stabilized—Changes in meter body temperature or static pressure have no effect on output shaft position. Meter operates efficiently in ambient temperatures of minus 40°F to plus 250°F.

Unmatched convenience features—Including fast range changing in the field . . . connections for both horizontal and vertical piping . . . quick calibration and adjustment . . . easy cleaning and servicing.

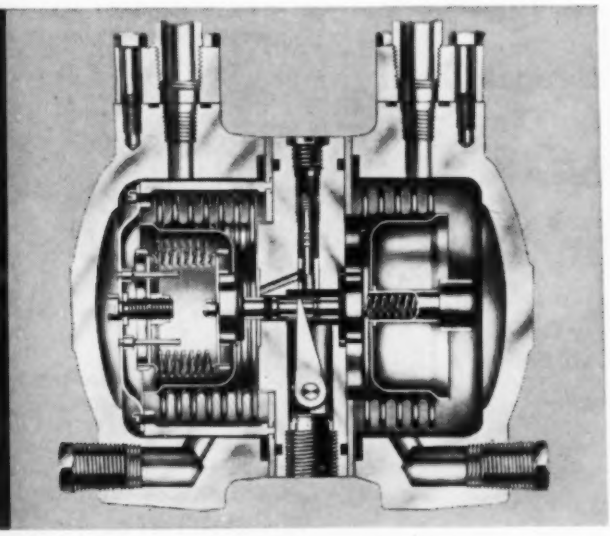
High corrosion resistance—Seamless, stainless steel formed bellows give long, trouble-free service with virtually all process fluids.

Fast, effective damping adjustment—New type pulsation check with rectangular orifice permits essentially linear damping adjustment . . . and adjustment from outside the meter body during operation.

Models are available in many ranges, for both flow and liquid level measurement and control. Get details on *all* the features of the new Honeywell Bellows Flow Meter by calling your nearby Honeywell field engineer today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA: Catalog C22-1**

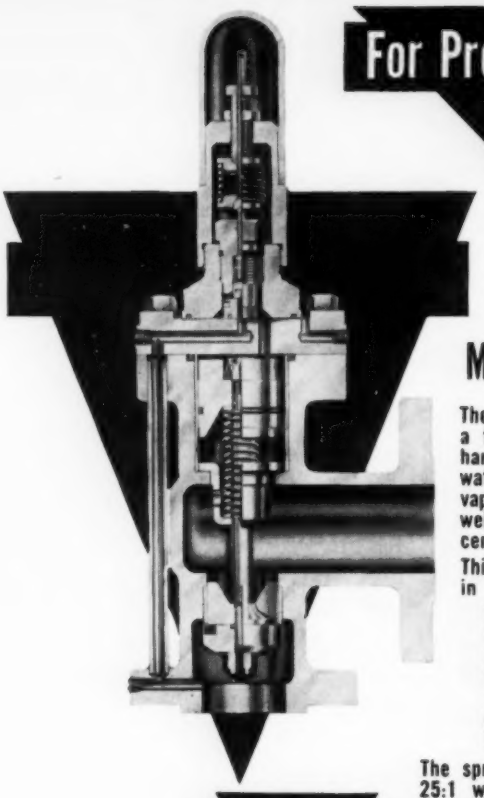


Transfer of liquid between opposing high and low-pressure bellows converts differential pressure measurement into motion. A torque tube assembly carries the motion outside the meter body to an instrument. Therefore, changes in differential pressure change the instrument reading.

75th YEAR
PIONEERING THE FUTURE

Honeywell

First in Control
SINCE 1885



For Pressure Relief of LPG, Gases or Vapors

Specify Kinzbach Model 414 Relief Valve

The new Kinzbach Model 414 relief valve with a flat seated pilot valve is designed to best handle fluids having a viscosity lower than water, such as light products, LPG, gases and vapors. The pilot valve can be either spring or weight loaded. Pressure blow-down of ten per cent permits pilot to reset for valve closure.

This relief valve incorporates advantages found in other Kinzbach relief valves of:

Positive action • dependability • instantaneous opening • automatic reseating • no chatter or wire drawing at seat • functional testing • simplicity and ruggedness • high capacity • positive seating • corrosion resistance • no pressure accumulation needed.

The spring loaded pilot ratio of the model 414 is 25:1 with working pressure ranges from 100 psi thru 1600 psi. For complete details on this and other Kinzbach pressure relief valves, write for catalog.

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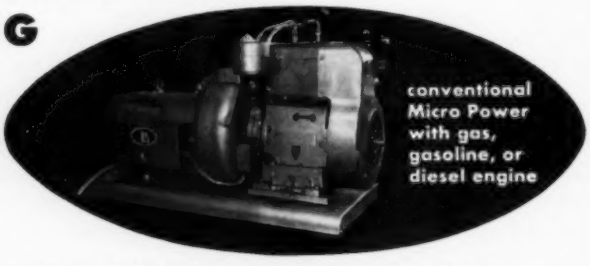

MICRO POWER

Heart of the microwave communications link between the Williams and the Seligman, Arizona, compressor station of El Paso Natural Gas Company is a United States Motors Corporation Micro Power. The engine of the conventional Micro Power in this case is replaced by a DC motor which is fed from the station batteries, from which all supervisory and telemetering equipment operates. Should the AC commercial power fail, the Micro Power continues to supply the microwave without voltage drop, droop, or break. Micro Power operates from, but isolates the microwave from the commercial power and removes the bad effects of voltage dips and peaks.

MICRO POWER operates with the main source of power. There are no transfer switches, no starting batteries with Micro Power. Available in 1500, 3000, 5000 and 10,000 watt capacities; for gas, gasoline or diesel engine emergency drive. For complete information, write . . .

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The American Gas Association has selected several pipe line company personnel to serve on the 1960 general nominating committee. **George P. Garver, president Natural Gas Pipeline Company of America; E. H. Tollefson, president Consolidated Natural Gas Co.; and C. H. Zachry, president of Southern Union Gas Company** were named to the committee and **Jac A. Cushman,** secretary of AGA, serves as committee secretary.

John L. Kyser has been named manager of **Phillips Petroleum Company's** supply and transportation department succeeding **Harry G. Fair** who was elected vice president of supply and transportation earlier this year.

Kyser joined the company in 1937 and was transferred to the coordinating division of supply and transportation in 1944. He had been assistant manager prior to his new position.

F. L. Freitag, assistant controller **Tennessee Gas Transmission Company,** has been elected to membership in the Controllers Institute of America. The institute is a management organization of controllers and finance officers from all lines of business.

W. I. Rainwater has retired after 36 years service with **Interstate Oil Pipe Line Company.** Since 1954 he had been head of property accounting.

WHO'S MEETING WHERE

January

NACE, Canadian region eastern division, Toronto, January 17-20.

NGAA, Gulf Coast regional meeting, Robert Driscoll Hotel, Corpus Christi, Jan. 22.

NACE, 5th annual Houston course in practical corrosion control systems, Rice Hotel, Houston, January 28-29.

Pipe Line Contractors Association, 12th annual meeting, Ambassador Hotel, Los Angeles, Jan. 31-Feb. 3.

February

Instrument Society of America, Instrument-Automation Conference and Exhibit, Rice Hotel and Houston Coliseum, Houston, Feb. 1-4.

Pipe Line Contractors Association of Canada, annual meeting, Empress Hotel, Victoria, B.C., Feb. 25-27.

NACE, Short course, Mayo Hotel, Tulsa, Feb. 24-26.

NGAA, Permian Basin Regional meeting, Lincoln Hotel, Odessa, Texas, Feb. 26.

AGA, general management section conference, Pittsburgh-Hilton Hotel, Pittsburgh, Feb. 29-March 2.

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KA-MO has the answer to your drilling problem

48-foot bore —

To run a gas distribution line under main highway, the pipeline contractor on this job used a portable Ka-Mo horizontal drill . . . quickly bored a 12" diameter hole, 48' long, through hard clay. Drill was powered by a 7½ h.p. air motor on a standard double-track mounting. On similar type work, casing can be installed at the same time hole is drilled by using the casing attachment which provides maximum protection against costly cave-ins.

Ka-Mo offers tremendous versatility . . . light, portable drills . . . easy to operate for installing gas lines under streets, highways, railroads. Drills through sand, clay, gumbo, frost, shale, limerock, other mineral formations. Air, electric, hydraulic, diesel or gasoline engine powered.

Vertical drilling for cathodic pipe protection

Ka-Mo truck mounted hydraulic unit used to simplify installation of anodes. This drill is available in sizes from 6" to 24" diameter. Gravity or pressure feed.

Next time you have a drilling problem, check the Ka-Mo line. Drill sizes: 2" to 48" dia. and larger, in sectionalized lengths, are tailored to meet your own particular requirements. Information is available at no obligation. Just mail coupon today.

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Send free data on:
☐ horizontal ☐ vertical
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Dia. of hole ..... inches
Length of bore ..... feet
Type soil .....

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KWIK-MIX COMPANY — Ka-Mo Tools Dept.
A DIVISION OF KOEHRING COMPANY

March

ASME, Gas Turbine Power Division, fifth annual gas turbine conference and exposition, Rice Hotel, Houston, March 6-9.

NACE, 16th annual conference, Dallas Memorial Auditorium, Dallas, March 14-18.

NGAA, Oklahoma Regional meeting, Biltmore Hotel, Oklahoma City, March 18.

Mid-West Gas Association, annual meeting, Hotel St. Paul, St. Paul, Minn., March 21-23.

New England Gas Association, annual meeting, Statler Hotel, Boston, March 24-25.

Oklahoma Utilities Association, annual convention, Biltmore Hotel, Oklahoma City, March 24-25.

April

Florida-Georgia Gas Association convention, Biltmore Hotel, Palm Beach, Fla., April 8-9.

PIEA-PESA, thirty-second annual petroleum industry conference and exhibition, Hotel Muehlebach and Municipal Auditorium, Kansas City, Mo., April 12-14.

Southwestern Gas Measurement Short Course, Drill Hall, North Campus, University of Oklahoma, April 19-21.

Indiana Gas Association, French Lick-Sheraton Hotel, French Lick, Ind., April 20-22.

Southern Gas Association, annual meeting, Galveston, Texas, April 25-27.

ASME Metals Engineering Division—AWS conference, Chase-Park Plaza, St. Louis, April 25-29.

American Welding Society, 41st annual meeting and exposition, Los Angeles, April 25-29.

NGAA, annual convention, Rice Hotel, Houston, April 27-29.

API, Division of Transportation, pipe line conference, Mayo Hotel, Tulsa, April 28-29.

May

AGA Operating Section, joint distribution and transmission conference, Roosevelt and Jung Hotels, New Orleans, May 9-13.

American Society for Metals, southwestern metal congress and exposition, Dallas, May 9-13.

Instrument Society of America, power instrumentation symposium, San Francisco, May 9-11.

ASME, oil and gas power conference and exhibit, Muehlebach Hotel, Kansas City, Mo., May 22-26.

Coating and wrapping facilities located near major pipe-producing areas provide buying flexibility, uniform protection

Because PLS plants with their vast storage areas are so strategically located, your pipe buying procedure can be greatly simplified . . . a load of detail lifted off your shoulders. You order from the desired pipe mill, specify delivery to the PLS plant serving the area, and we take it from there! There's always room at our 150 acres of plant sites to store your pipe until the exact time of need. Pipe can be released for processing and be on its way to the project in a matter of a few days. Savings in time often add up to weeks when plant-applied coatings are specified. Delivery of PLS coated and wrapped pipe is assured WHEN you want it, where you need it. So, let PLS carry that load for you. Call our nearest representative and get all the details.

Sales offices at all plant locations...and Atlanta, Georgia; Houston, Texas; Lincoln, Nebraska; Syracuse, New York; and Dallas, Texas

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Pipe Line Service Corporation

FRANKLIN PARK, ILLINOIS

Quality pioneers in coating and wrapping pipe for over a quarter century

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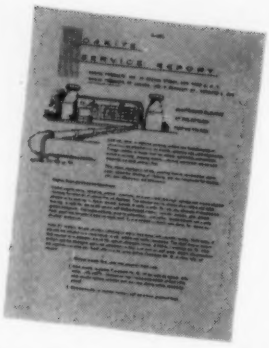

This report helps you save on pump-station maintenance

Here's a new Oakite Service Report – free, of course – on maintenance cleaning at the pipeline pumping station.

It's full of valuable, time-saving ideas ... any one of which might turn out to give you a deep cut in maintenance costs. You'll find helpful shortcuts on:

- Engine room maintenance
- Lube oil cooler maintenance
- Cleaning electric motors, generators, control panels, etc.
- Paint stripping
- Storage tank cleaning
- Cleaning crude and natural gas lines

FREE. Write for a free copy of this Oakite Service Report No. B6878. Address Oakite Products, Inc., 51A Rector Street, New York 6, N.Y.

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What's Happening among SERVICE and SUPPLY MEN

Col. Rockwell Receives "Honor Certificate Award"

Col. Willard F. Rockwell, chairman of the board of Rockwell Manufacturing Company, recently was presented a Freedoms Foundation "Honor Certificate Award." Dr. Kenneth D. Wells, right, president of Freedoms Foundation at Valley Forge, made the presentation. The award is for "outstanding speeches and writings in the economic education field." In 1950 Col. Rockwell received an award for "outstanding achievement in bringing about a better understanding of the American Way of Life" from the same organization.

Jones & Laughlin Names Two District Sales Managers

Henry Franks has been named district sales manager for Central Rocky Mountain District at Casper, Wyo., and C. W. Moore has been appointed manager of Eastern Oklahoma District for Jones & Laughlin Supply Division.

Franks fills the vacancy created by the recent death of Marvin Park and Moore succeeds the late A. A. Hooper. Franks joined the company in 1950 and was promoted to manager, Sub-Surface Equipment section in 1957. Moore has been with Jones & Laughlin for 36 years and prior to his appointment had been supervisor of store construction and maintenance.

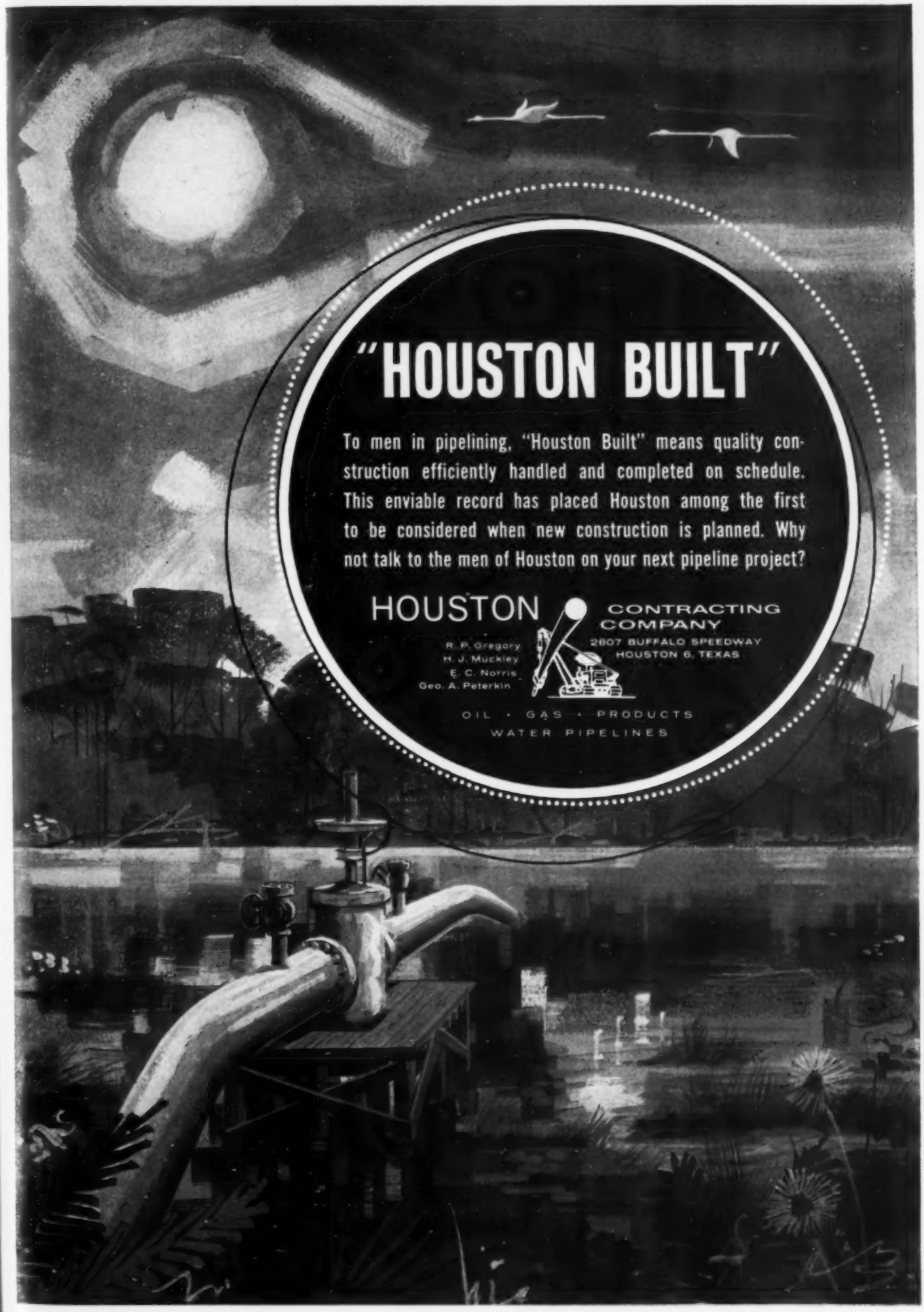
Youngstown Sheet & Tube Announces Indiana Harbor Works Expansion Plans

Youngstown Sheet and Tube Company announces plans for five major expansion projects at its Indiana Harbor Works. Projects include installation of a 52-inch six-stand tandem cold reducing mill; installation of the company's first continuous galvanizing line in Youngstown's large galvanized sheet market; construction of an 87-oven coke battery; an ore dock extension to improve handling and storage facilities for additional raw materials; and additional equipment for finishing seamless tubing.

Allis-Chalmers Appoints Two West Coast Managers

Allis-Chalmers Manufacturing Company has appointed W. L. Haslam manager, chemical and metal sales in San Francisco, and Alan Purchase manager, industrial sales, Los Angeles.

Haslam has been with the company since 1951 and has been in the Los Angeles district since 1954. Purchase joined Allis-Chalmers in 1949 and has been manager of industrial sales in San Francisco since 1956.


"HOUSTON BUILT"
To men in pipelining, "Houston Built" means quality construction efficiently handled and completed on schedule. This enviable record has placed Houston among the first to be considered when new construction is planned. Why not talk to the men of Houston on your next pipeline project?
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H. J. Muckley
E. C. Norris
Geo. A. Peterkin
OIL • GAS • PRODUCTS
WATER PIPELINES

From...

the SIMPLE to the COMPLEX

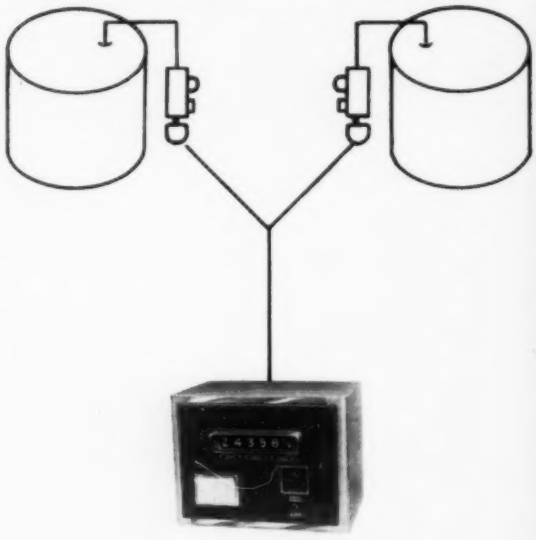

FIG. 9310 SERIES RECEIVER

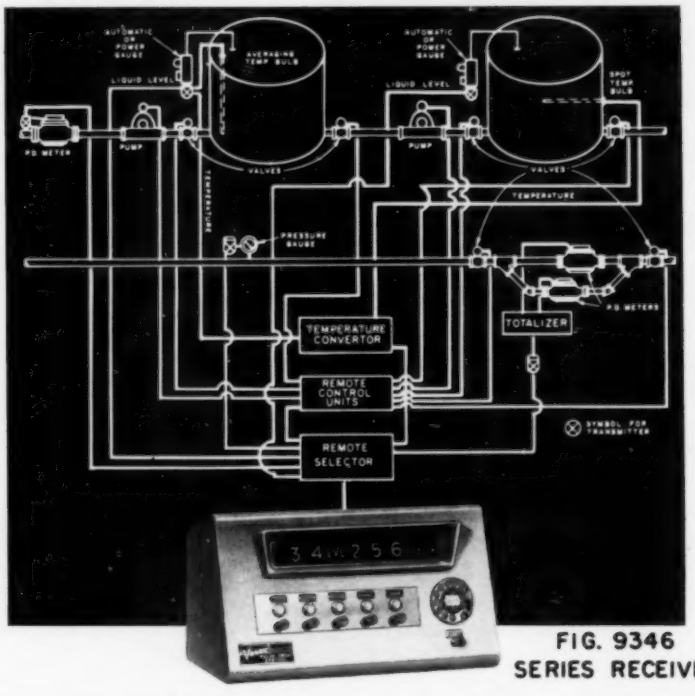

FIG. 9346 SERIES RECEIVER

"Varec" ***PULSE CODE SYSTEMS****

Custom-built of Standard Field-tested Units

One or hundreds of tanks. One measurement or many. Control function and alarm signals. A few feet or hundreds of miles. Direct wire, low grade communication pair, tone or microwave. Manual selection or programmed scanning with automatic lockout. Digital readout. Transceiver output suitable for entry into almost any conceivable type of digital data processing equipment.

That's "Varec's" Pulse Code Telemetering System designed specifically for the petroleum and petro-chemical industries to remotely indicate measurements and alarm conditions and to perform supervisory control functions.

Simplicity of application is matched by simplicity of instrumentation. Complexity of application is matched not by complex instrumentation, but by combining production line "building block" units in an arrangement commeasurable with requirements.

A complete "Varec" Pulse Code Automation System can handle with a single or multiple receiver installation the following:

Liquid Level, Flow (P.D.M.) Volume, Temperature, Pressure, Valve Control, Pump Control, Supervisory Data Gathering and Reduction.

For complete information on "Varec" Pulse Code Systems, we invite you to contact your nearest "Varec" representative, or send for New Bulletin CP — 3707.

* Patents Pending
U.S.A., Great Britain, Japan
Patented
France, Pat. No. 1,163,861

"Varec"
TRADE ® MARK

THE VAPOR RECOVERY SYSTEMS COMPANY

P-7

"VAREC", 2820 NORTH ALAMEDA STREET, COMPTON, CALIFORNIA. *Branches and Representatives in Principal Cities.*

John Behrenfeld

John W. Brand

Ben Montgomery

W. H. Royal

Crose and Perrault Announce New Company Name, Several Promotions

The new name for the combined M. J. Crose Mfg. Co., Inc., and Perrault Equipment Co. upon completion of their merger will be Crose-Perrault Equipment Corp. Both companies are well known throughout the industry and both names are to be included in the organization.

Several promotions have been announced by Crose in conjunction with the merger. John W. Brand, vice president of M. J. Crose, becomes vice president and general manager. He will retain management of the Crose-Curran, Ltd., Canadian subsidiary. John Behrenfeld, vice president, will be transferred to New York where he will be in charge of the Crose Export Department. Ben Montgomery has been named a vice president. He will remain in Houston as head of the Houston Division. W. H. Royal has been named sales manager succeeding Behrenfeld and has been moved to Tulsa from Denver. At Denver he was in charge of the Western Division of Crose.

Dunwoody Pipe & Supply Co. Appoints Link Sales Manager

Dunwoody Pipe & Supply Co. has appointed E. Cary Link, Jr., sales manager of its newly formed line pipe Sales Department. Link, formerly vice president with Jess Edwards, Inc., began his pipe line career with War Emergency Pipeline, Inc.

E. Carry Link, Jr.

Link was with Tennessee Gas Transmission Company from 1943 to 1946. Later he worked with Fish Constructors on building of the Transcontinental Gas Pipe Line system and Pacific Northwest line. At Dunwoody he also will direct a new pipe coordination service, assisting pipe line companies in disposing of surplus inventories.

GEM
OF THE
OIL AND GAS
INDUSTRY

Lone Star Steel men are specialists . . true craftsmen. Lone Star is not just a steel plant *per se* . . but an organization of craftsmen specializing in fine pipe for the great and growing oil and gas industry.

At Lone Star . . with the finest tools and equipment . . steel craftsmen make API casing, tubing, and line pipe to a precise quality level that is well known.

Lone Star pipe is the gem of the oil and gas industry.

Lone Star STEEL COMPANY

EXECUTIVE—SALES OFFICES
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DISTRICT SALES OFFICES
912 Republic National Bank Building, Dallas, Texas
Houston, Texas | Midland, Texas | Tulsa, Oklahoma

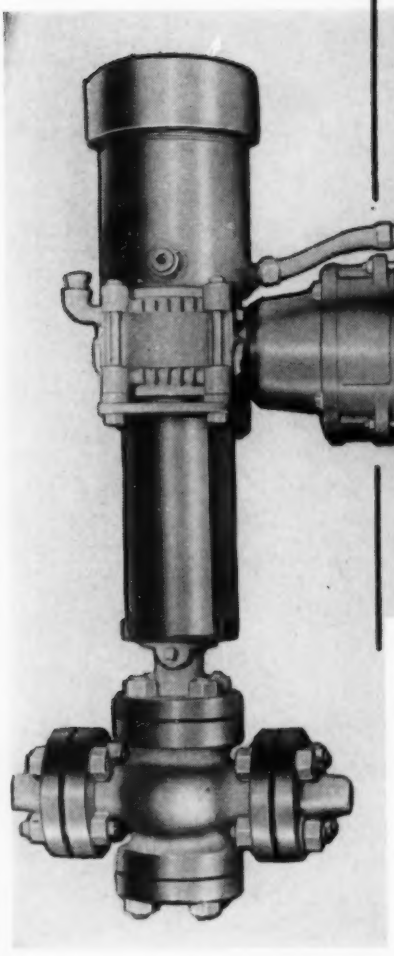
For more data on advertised products, use Readers' Service Cards, last page.

I·P·E *Presents*

the

First Truly Electronic

PROCESS CONTROL VALVE OPERATORS



Here they are—the first truly electronic control valve operators in the pipeline industry! Motor starting, stopping and reversing control are completely electronic operations—no hydraulic or pneumatic elements, no mechanical switches or relays.

1. Frequency response and transfer function characteristics equalling those of pneumatic operators
2. High torque and high thrust capabilities
3. Adaptable to all electronic process controllers and the new I★P★E Model NB-P
4. Motor excitation and control is by fully electronic devices (employs no relays, motor starters, or other "brute force" devices)
5. Motor control auxiliaries available in vacuum tube and solid state circuitry
6. Motor control circuitry in printed circuit modular construction for easy and low cost maintenance
7. Stroke lengths and speeds to meet all valve sizes and process requirements
8. Adaptable to plug, butterfly or standard gate valves in addition to conventional control valves
9. Seven wires (maximum) required to connect motor to control center (no susceptibility to noise disturbances in these leads)
10. Easy and low cost maintenance

Other Products:
Process Controllers and Special Purpose Analog and Digital Computers.

For further details write or call:

Electronics Division of
INDUSTRIAL PROCESS ENGINEERS, INC.
12 LISTER AVENUE • NEWARK 5, N. J.

Allied Paint Mfg. Co. Forms Perrault Supply Co., Division

Perrault Supply Co. has been formed as a division of Allied Paint Manufacturing Company, Ainslie Perrault, president, has announced.

V. V. Malcom

V. V. Malcom, formerly vice president and general manager of Perrault Equipment Co., has been named general manager of the division. The new division will specialize in equipment for combatting corrosion of pipe lines. Malcom previously had been an engineer and manager for the Philip Carey Manufacturing Co.

Items handled by the new division include pipe line felt, rock shield, glass pipe wraps and internal coatings. Anderson-Lundberg Corp., New York, has been named eastern and export representative for Perrault Supply Co.

Pittsburgh Coke & Chemical Co. Names Martin Project Manager

Pittsburgh Coke & Chemical Company has named John W. Martin project manager of the Commercial Development Department. He will analyze and coordinate various chemical projects with respect to their business potential. Before coming to Pittsburgh, he had been with Koppers Company and Virginia Smelting Company.

Southwestern Pipe Appoints Two Sales Representatives

Southwestern Pipe, Inc. has appointed Ralph Hickey and Morris Varnadere sales representatives in the West Texas, New Mexico, Oklahoma and Kansas areas.

Hickey will cover Oklahoma and Kansas with offices in Tulsa. Varnadere will serve West Texas and New Mexico with offices in Midland. Hickey had been with L. B. Foster Company before joining Southwestern and Varnadere previously had been an independent oil operator.

CLASSIFIED ADVERTISING

PIPE
500,000 ft. 10¾" O.D. 35#
200,000 ft. 8⅝" O.D. 28½#
100,000 ft. 12¾" O.D. 40#
20,000 ft. 16" O.D. 42#
all No. 1 grade, plain end cleaned.
INDIANA-OHIO PIPE CO.
P. O. Box 5412 Shepard Sta.
Phone C.L. 3-5527. Columbus 3, Ohio

SALESMAN WANTED

Well-established successful firm has opening in an expanding sales department for young man looking for an opportunity in sales work. Must be college graduate, not over 33, in good health, ambitious and not afraid of work. Oil industry experience desirable. The man we are looking for will be trained at home office before moving into sales work on basis of salary plus commission incentive and traveling expenses. Our own personnel know of this advertisement. Your reply will be confidential and should be sufficiently complete to merit contacting you for an interview. Address Box 56-P, PIPE LINE INDUSTRY, Houston, Texas.

Maintenance Cost Too High?

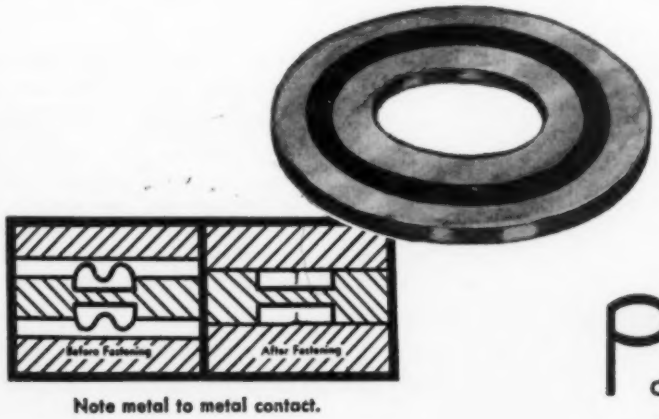
How much time, effort, and money is spent cleaning, resurfacing and/or replacing flanges to replace the seal!

Expensive? Yes!

Why not find out about Gask-O-Seals and save! Here are the facts: With Gask-O-Seal, flange faces require little or no cleaning or resurfacing of flanges when replacing the seal — *and Gask-O-Seals are re-usable.*

Gask-O-Seals save money and effort in many other ways, too. They are visually inspectable, do not need to be re-torqued, there is no material creep and they are non-directional, non-flexible, easy to install. They provide no-leakage sealing, *can not blow out,* and there is no wear due to pulse.

Now available to fit ASA standard flanges. Write for free catalog.



Note metal to metal contact.

Parker SEAL COMPANY

CULVER CITY, CALIFORNIA and CLEVELAND, OHIO

A DIVISION OF PARKER-HANNIFIN CORPORATION

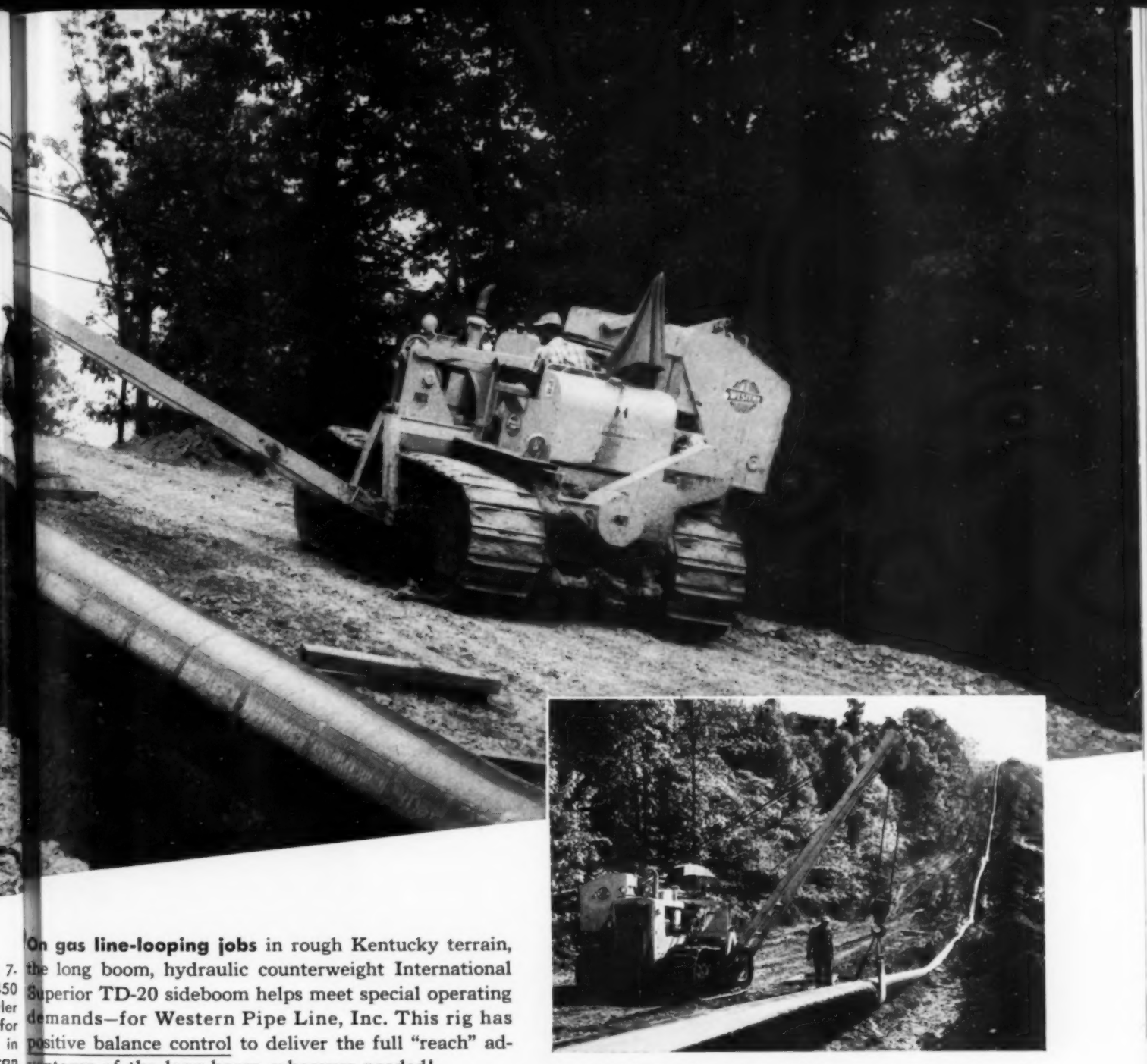
Note the advantage of 7-roller track flotation and traction as Western Pipe Line, Inc., use their new International Superior TD-20 to help beat the effects of prolonged wet weather, looping gas lines in Kentucky. High-clearance sideboom hinge points and completely enclosed engine and transmission guards save vital time in such conditions!

Long-boom TD-20 adds reach to speed line-looping

—for Western Pipe Line, Inc., Austin, Texas

Even with 16' overhang the 7-roller TD-20 can handle an 18,450 lb. load of pipe! Correct crawler balance and counterweighting for stability add time-saving "reach" in many operating situations! You can get boom lengths from 16' to 22' on the TD-20 sideboom!

Fast, efficient pipe-padding is done for Western Pipe Line, Inc.—with the exclusive clam-action bottom dumping of their International® Drott® TD-15 Four-in-One. "The 4-in-1 saves time and additional laborers in right-of-way operations," states J. R. Wells, Spread Superintendent. "It's ideal for pipe-padding and final right-of-way clean up."



"**I particularly like the TD-20's** long boom and narrower width which makes passing easier on loop-laying," reports Monroe Brantley, Lowering-in Foreman. "The TD-20 rig is balanced to handle up to 30-inch pipe—and the hydraulic counterweight gives ideal control for maximum laying distance with the long boom."

On gas line-looping jobs in rough Kentucky terrain, the long boom, hydraulic counterweight International Superior TD-20 sideboom helps meet special operating demands—for Western Pipe Line, Inc. This rig has positive balance control to deliver the full "reach" advantages of the long boom, wherever needed!

At four feet overhang, the International Superior TD-20 hydraulic counterweight sideboom lifts 75,000 lbs. This 134-hp model gives you the smoothness and high torque wallop of a 6-cylinder International Diesel engine.

On new 7-roller tracks* and 24-inch shoes, the TD-20 sideboom has 36 square feet of track-on-ground flotation-traction! With new stability, you get new mobility of 6-speed, full-reverse transmission—with instant Shuttle-Bar forward-reverse direction changing!

You get the famous International Superior operating ease of vertically-stacked, reach-easy control levers for operating ease and safety. Exclusive, gear-driven drum shafts operate without adjustment, clatter, or backlash. You get the cable life protection of fleeting sheaves —"minute-change" counterweighting—many other pipeliner-proven advantages.

Compare long-boom TD-20 sideboom advantages. See how long boom reach teams with two fast double-acting hydraulic cylinders to give you super-speedy accurate counterweight positioning. Measure the value of high hinge-point clearance for soft footing operations. See how Shuttle-Bar control adds speed and operating ease. See your International Superior Distributor for a demonstration!

*Optional

International Harvester Company, Chicago 1, Illinois

INTERNATIONAL®

SUPERIOR®

What's New in EQUIPMENT

To receive more information on all new equipment articles use Readers' Service Card, last page of this issue.

D9 Series E Tractor

Caterpillar Tractor Co. announces availability of a new series D9 tractor. The unit is available in a choice of direct drive or torque converter drive and the new power shift transmission. Horsepower is up from 320 to 335 and the unit is 1 7/16 inches longer and 1 inch higher. A new track group is featured on the new series.

Improvements have been made for long flange life on track rollers. A cam-type equalizer bar provides better machine stability, particularly in side-hill operations. A new turbocharger, smaller and capable of operating at higher output, has been developed. Oil control on the turbocharger is improved by use of a one-piece center housing. Hydraulically-controlled Nos. 9S, 9A and 9U bulldozers are offered on the D9 for the first time. They are controlled by the new, high-capacity No. 184 hydraulic control unit. Another hydraulic unit No. 143, is available for D9 tilt cylinder only, when the tractor has a cable dozer. The new No. 9 ripper also is offered for the D9.

(This item supplements Caterpillar Tractor Co. data on pages 76-79 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E1** on Readers' Service Card, last page this issue.

Filter Kits

Krause Mfg. & Supply Co., Inc., has developed a dry air filter kit designed for pre-cleaning engine air on construction equipment when heavy dust becomes a problem.

The filters are easy to install and maintain. Elements in dry type filter can be serviced by gently tapping elements on the side to dislodge dirt and then using compressed air to reverse air flow. All elements are vertically mounted providing self-cleaning action from normal engine vibration. A free tilting cover provides an even pressure on the end of the unit for a positive seal of the gasket and longer life.

For more data, circle **No. E2** on Readers' Service Card, last page this issue.

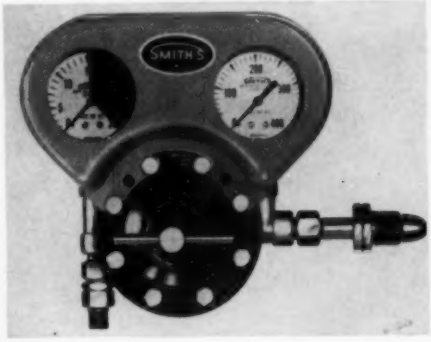
Tape Sealer

A chemically-inert plastic tape to seal and permanently lubricate threaded and coupled joints has been developed by Minnesota Mining and Manufacturing Co. The Dry Thread Sealer No. 4212 can be applied in seconds and conforms to all types of pipe threads and fittings in low or high pressure system.

A few of the applications include gas meter hook-up, conduits, couplings, valve sealing and high pressure systems.

Due to its non-adhesive characteristics, joints can be loosened and detached years after the threads are taped. The ½-inch wide tape is available in 260-inch or 520-inch lengths on handy pocket size rolls.

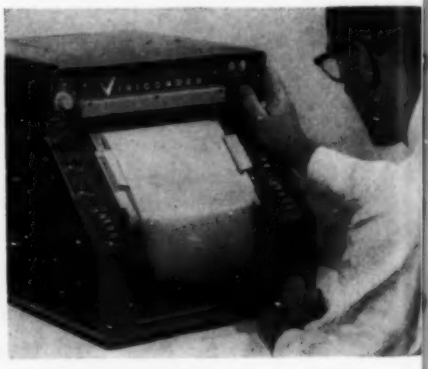
For more data, circle **No. E3** on Readers' Service Card, last page this issue.



Safer Regulator

Smith Welding Equipment Corporation has introduced a regulator with new safety features for the welding industry. The Saf-T-Pak regulator is designed to eliminate three of the commonest dangers of mis-use. A regulator "hard-hat" encloses the gages, protecting them from exterior abuse. The "flo-trol" on the down stream side prevents reverse flow and mixture of gases, curbing an explosive danger in regulator use. A safety inlet connector fits the inlet connection to the regulator, for quick repair of damaged connections without special tools. The regulator is available for use with oxygen, acetylene and LP gases.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.



Oscillograph

Minneapolis-Honeywell Regulator Company announces a direct-recording oscillograph, the lowest in cost-per-channel of its Visicorder line.

The new model, Visicorder 1108, is designed to allow high speed recording of up to 24 channels of scientific and test data simultaneously. The 1108 unit is a dry and dustless direct-recording oscillograph that produces instantly-readable records without the use of powders, inks, stylus heat, electrostatic charge, or chemicals.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

Hinged Closures

A compact, factory assembled unit consisting of a hinged blanking cap, welding hub, two-piece yoke and a self energizing static O-ring gasket, Tube Turns hinged closures can be operated by one man. Closures can be furnished for vertical installation with counterbalanced caps for easy operation and are equipped with double bolts having attached wrenches.

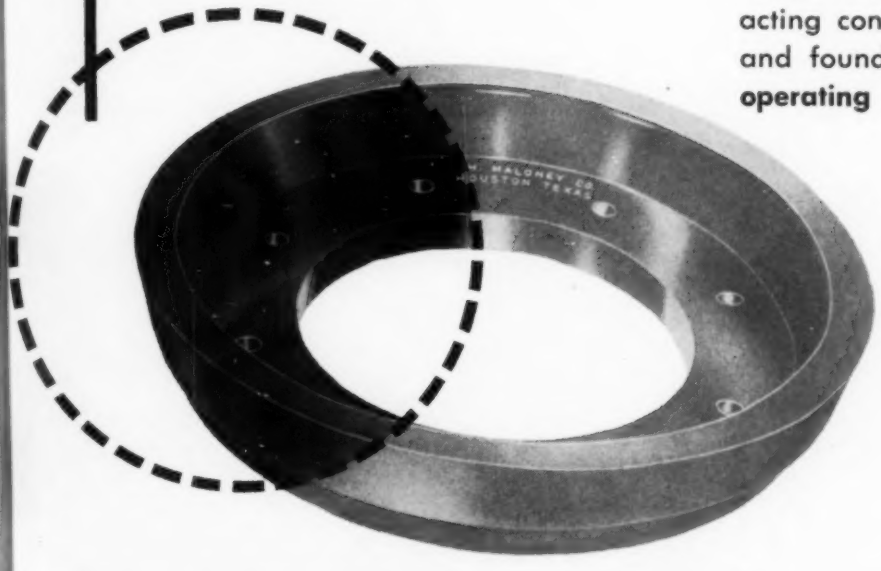
The closures are designed to prevent accidental opening while under full line pressure. The units are available in carbon

TOUGH...

WHERE IT COUNTS!

More weight **where it belongs** — on the wearing area. Deeper lip with an L-profile providing controlled flexibility allowing full efficiency for the full depth of the lip. Uniform wear in all kinds of pipe under **all** conditions. Maloney scraper cups **really** get tough . . . for **extra** strength and **longer** life in any pipeline service.

Tireless research—proven design—exacting consistent manufacture—tried and found true **where it counts:** in **operating** pipelines.



Maloney scraper cups and discs are available for immediate shipment in all sizes upon receipt of order.

SCRAPER CUPS AND DISCS

. . . THE STANDARD OF THE INDUSTRY

"Something From The Irishman"

F. H. Maloney COMPANY

OFFICES IN
CHICAGO • LOS ANGELES
PITTSBURGH • TULSA

2301 TEXAS AVENUE
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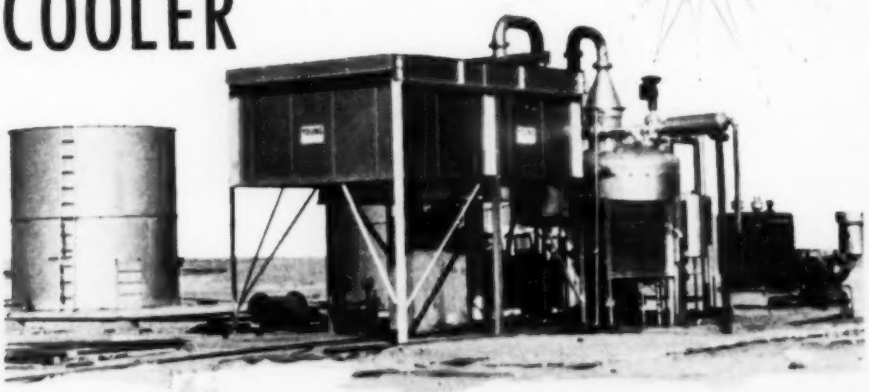
"PRECISION IN RUBBER • METALS • PLASTICS"

For more data on advertised products, use Readers' Service Cards, last page.

HC® by Young...

Horizontal Core ATMOSPHERIC COOLER



Provides 25,000 Gals. of Pure Drinking Water Per Day at Remote Desert Drilling Site

Converting oil-contaminated water into sparkling-pure drinking water has been achieved by the use of an HC® by Young horizontal core atmospheric cooled condenser in a submerged combustion process. This unit condenses 25,000 gallons of pure water a day under arid desert operating conditions.

Used throughout the oil fields and industry for large volume cooling of water, oil, and gases as well as condensing vapors, these HC® units are available in a variety of sizes with capacities ranging up to 25,000,000 btuh for water cooling to 10,000,000 btuh for oil cooling. Young-engineered core efficiency and unit design reduces power requirements. . . increases heat transfer.

Young

makes a complete line of efficient heat transfer equipment for Petroleum, Chemical and Industrial Application

OIL COOLERS

SUPERCHARGER INTERCOOLERS AND AFTERCOOLERS

ENGINE JACKET WATER COOLERS

TORQUE CONVERTER COOLERS

WRITE FOR LITERATURE ON ANY YOUNG PRODUCTS

Compact design permits space-saving and in-line installations of two or more HC® units to operate at top efficiency without interference from cross-winds or blanket core face. Parallel series installations can give unlimited cooling capacities.

Young *ideas for solving heat transfer problems are GOOD IDEAS*

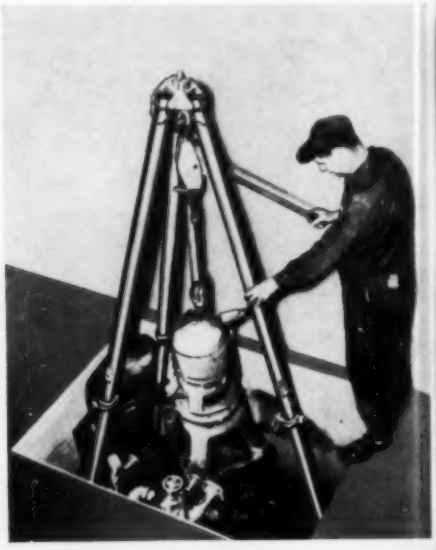
YOUNG RADIATOR COMPANY DEPT. A-390 RACINE, WISCONSIN

PLANTS AT RACINE, WISCONSIN AND MATTOON, ILLINOIS

steel in sizes 2-inch through 42-inch in ASA 150-pound, 300-pound and 600-pound pressure classes. Other sizes, pressure classes, metals and alloys are available on special order.

(This item supplements Tube Turns, Division of Chemetron Corp., data on pages 446-447 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E6** on Readers' Service Card, last page this issue.



Adjustable Tripod

A new adjustable tripod for hoisting heavy equipment in cramped spaces has been announced by B. E. Wallace Corp. The tripod has three telescoping legs that adjust separately and each is equipped with a removable base pad.

Six models are available—smallest has a height adjustment from 4 feet to 6 feet 9 inches, and the largest from 10 feet to 17 feet 3 inches.

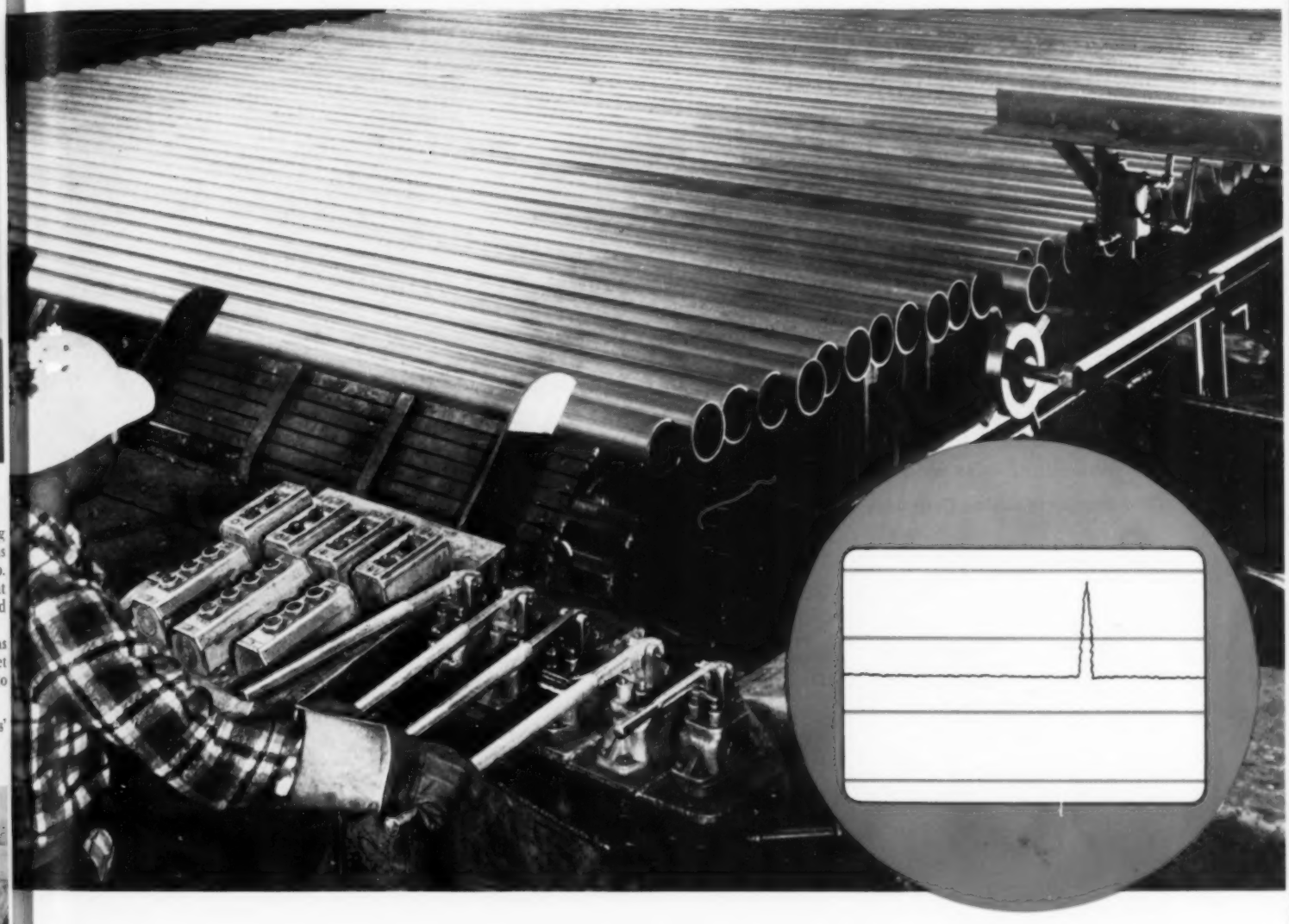
For more data, circle **No. E7** on Readers' Service Card, last page this issue.

Switchgear Housing

Allis-Chalmers Manufacturing Company announces an all-aluminum outdoor switchgear housing developed in conjunction with Reynolds Metals Co. Aluminum extrusions are snapped together to form the housing which requires no paint for protection. Snap-tight interlocking panel edges form a leak-proof joint. Lighter weight and modular construction speeds handling and installation at the job site; minor adjustments easily can be made. The Alumna-Clad housing design permits an increased air flow through filters in the bottom and out of the top of the

Acme-Newport

ELECTRIC WELD LINE PIPE



Quality checked by eyes human and electronic

Now Acme-Newport brings the powerful eye of electronics to the continuous quality testing already being given the line pipe produced in this plant. This new procedure is a worthy addition to the keen personnel, modern facilities and 75 years' experience that here ensure good steelmaking, pipe formation, electric welding, and long uninterrupted service in the field. The use of electronic testing is one more advance in the continuous effort to attain and maintain top quality in every length of regular and thin wall pipe. Here indeed is pipe you can buy with utmost confidence!

SIZES AND WEIGHTS AVAILABLE

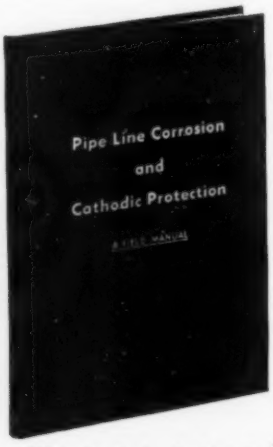
O.D.	Wall	Wt. Per Ft.
4½	.125"	5.84
	.142"	6.61
	.156"	7.25
	.188"	8.64
	.219"	10.00
	.237"	10.79
6⅝	.156"	10.78
	.188"	12.89
	.219"	14.97
	.250"	17.02
	.280"	18.97

Acme-Newport Steel COMPANY
NEWPORT, KENTUCKY
A SUBSIDIARY OF ACME STEEL COMPANY

Only a Jaeger can deliver 600 cfm of air at 1700 rpm

Using the same Model 6-71 GM diesel engine, a Jaeger "600" rotary delivers the same air volume at 1700 rpm that other compressors must speed up to 1800 rpm to produce. You save fuel and wear, with as many as 48,000 *fewer* compressor revolutions, every day you work. • Jaeger 125, 250 and 365 cfm rotaries have this same high efficiency characteristic. Ask your Jaeger distributor to demonstrate — or send for Catalog JCR5.

The Jaeger Machine Company, 665 Dublin Ave., Columbus 16, Ohio



The most practical on-the-job manual for men concerned with pipe line corrosion.

Pipe Line Corrosion and Cathodic Protection

By MARSHALL E. PARKER

This book is designed as a practical field manual. It provides workable methods that can save you valuable time and effort in obtaining interpretive field data.

Contents (Condensed). Soil Resistivity Surveys, Pipe-to-Soil Potentials, Line Currents, Current Requirement Surveys, Rectifier System for Coated Lines, Ground Bed Design and Installation, Magnesium Anodes on Coated Lines, Hot Spot Detection, Stray Current Electrolysis, Interference in Cathodic Protection, Operation and Maintenance, Coating Inspection and Testing.

Appendices cover: Fundamentals of Underground Corrosion, Basic Principles of Cathodic Protection. Plus . . . tables and properties of metals, attenuation equations and index.

108 pages, illustrated. . . . Price $3.00

Send for your FREE copy of the New Petroleum Book Catalog which describes the nature and contents of many books pertaining to the Petroleum Industry.

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Book Department
GULF PUBLISHING COMPANY
P. O. BOX 2608
HOUSTON 1, TEXAS

housing. Removable floor panel extrusions permit access to the area beneath the switchgear housing. The interlocking sections can be removed one at a time for inspection purposes.

(This item supplements Allis-Chalmers Manufacturing Company data on pages 41-44 of the Pipe Line Catalog, Second Revision.)

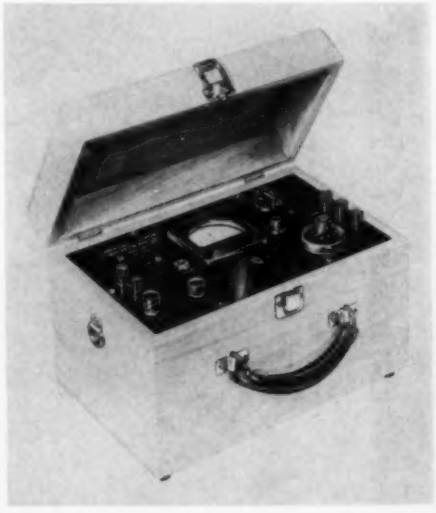
For more data, circle **No. E8** on Readers' Service Card, last page this issue.

Holiday Detector

The Perram Pacc holiday detector developed by Cathodic Corrosion Control Limited is a small portable unit. Power supply is built in and is from special light non-spillable batteries. Circuit is based on transistors with consequent savings in weight and space. Output is in 2KV steps from 6 to 20 KV negative DC. A meter is built in to give actual applied voltage.

Holiday indications are sound and visual and both indications can be made to operate at any desired leakage current over 100 microamperes.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.



Cable Fault Locator

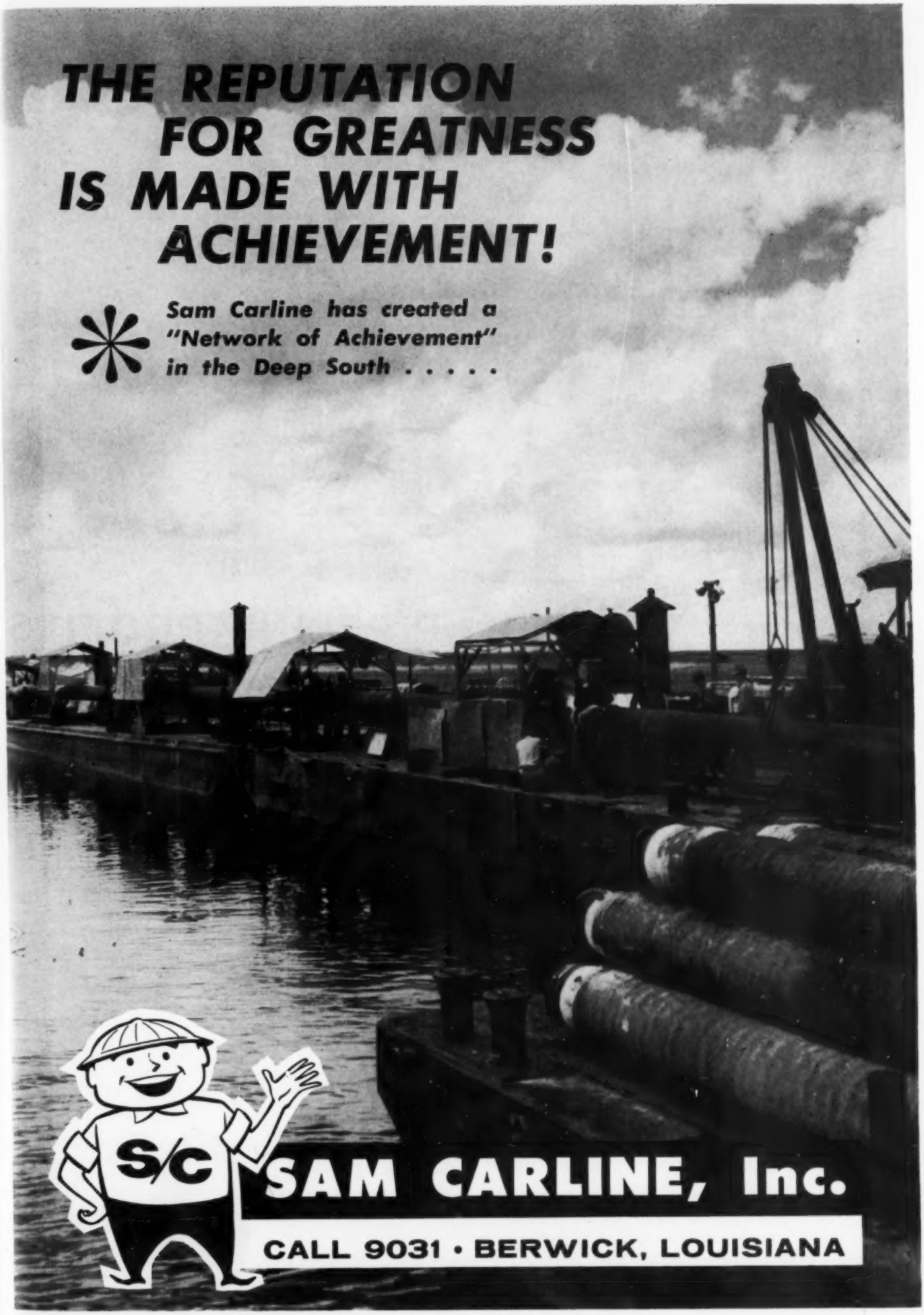
A self contained portable unit which locates open conductors, shorts, grounds, high-resistance faults, crosses and split pairs in plastic and rubber insulated cable, has been announced by Whitney Blake Company. The unit is battery operated and contains a transistorized 100-cycle tone source and a high gain tune amplifier for null detection. The null or balance point is attained by a single dial and is indicated by an easy to read meter.

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

Hydraulic Pump Motors

General Electric announces a new line of hydraulic pump motors in NEMA frames 182 through 215. The pumps are available in drip-proof, enclosed or explosion-proof, construction. Pump mounting adapters can be supplied that will accept pumps of many types. They are available on both ends of drip-proof and enclosed non-ventilated motors.

Also flexible couplings that assure proper shaft alignment and virtually eliminate bearing loads from misalignment can be furnished. The coupling has no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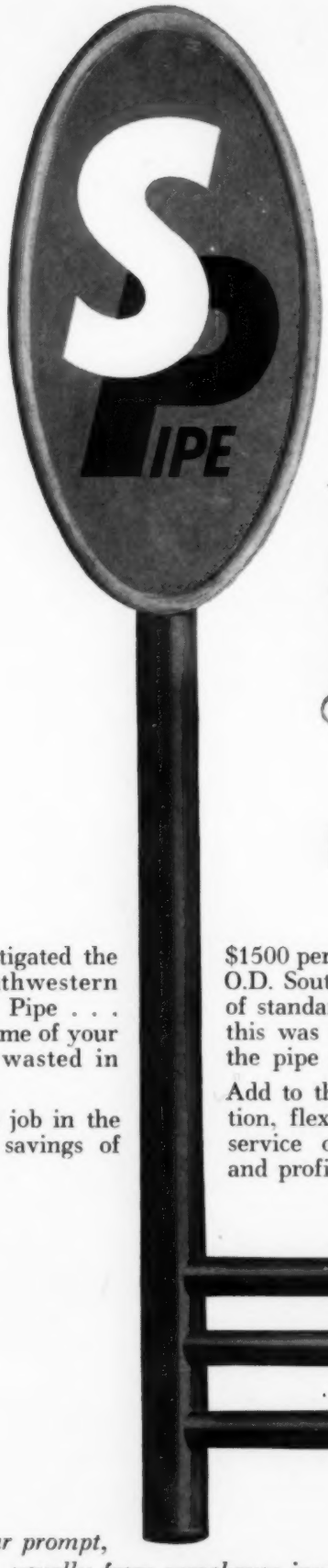

KEY to PIPELINE PROFITS

If you haven't investigated the advantages of Southwestern LIGHTWALL Line Pipe . . . it's a good bet that some of your potential profit is wasted in pipe cost.

On a recent 35-mile job in the mid-continent area savings of $1500 per mile were made by using 4.500" O.D. Southwestern LIGHTWALL instead of standard weight of the same size—and this was a savings on the initial cost of the pipe alone.

Add to these savings the ease of installation, flexibility and the long trouble-free service of Southwestern LIGHTWALL and profits mount still further.

You can depend on our prompt, reliable deliveries . . . usually from warehouse inventories.

SOUTHWESTERN PIPE, INC.*

**Corporate name changed from Southern Sales & Transportation Co. May 1st, 1959*

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LICENSED BY THE AMERICAN PETROLEUM INSTITUTE

rubbing surfaces to wear and requires no grease; it can be assembled quickly.

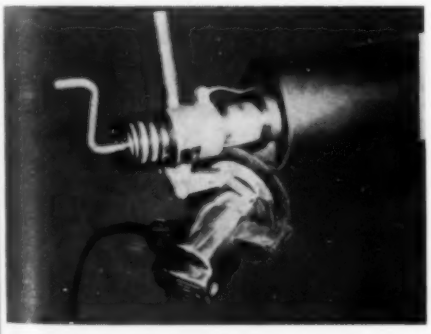
(This item supplements General Electric Co. data on pages 199-202 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

Pipe Locator

A new pipe locator has been introduced by Goldak Co. The detector locates and traces pipes, cables and conduits to a depth of 18 feet. It can also pinpoint valves, caps, risers, junction boxes, etc. It is a lightweight completely transistorized unit and requires only small flashlight batteries for power.

For more data, circle **No. E12** on Readers' Service Card, last page this issue.



Grinding Machine

Development of an automatic electric driven grinding machine to smooth and put lands on bevels has been announced by H & M Pipe Beveling Machine Company. The grinder is available in two models for pipe ranging from 6 to 26 inches. One model handles pipe up to 14 inches; the other fits 14- to 26-inch pipe.

The grinder is locked in place inside the pipe, and a simple adjustment converts it from a cleaning machine to the landing position.

This item supplements H & M Pipe Beveling Machine Company data on Page 229 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E13** on Readers' Service Card, last page this issue.

Remote Control Unit

A new "Kixcel" remote control drive unit allows most Fisher Governor pilot operated gas regulators to be set remotely. The electric powered unit turns the pilot's adjusting screw either for an increase or decrease in the reduced pressure of a system. It is controlled from a remote location by means of telemetering equipment or a DC control signal supplied from a polarized signal transmitter.

Features include quick and easy manual adjustment, fully adjustable pressure limit switches and various rates of pressure change.

For more data, circle **No. E14** on Readers' Service Card, last page this issue.

Fire Detectors

Falcon Alarm Company has improved visual inspection of its automatic fire detector. A sight glass has been added to the automatic freon powered fire alarm so that the level of the liquefied gas can be checked quickly.

The new models are more compact and are easy for an individual to install with a screw driver. They are available with temperature ratings of either 136° F or 174° F. When heat of fire reaches rated temperature, a loud warning sound can be heard at great distances outside.

For more data, circle **No. E15** on Readers' Service Card, last page this issue.

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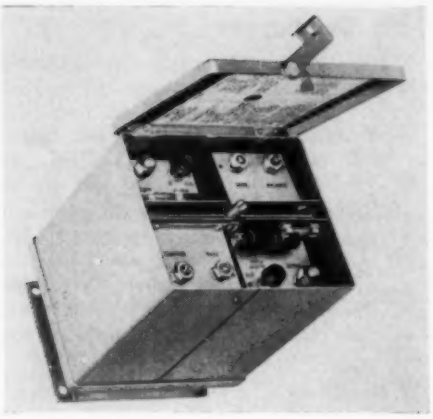

Electronic Alarm

A self-powered electronic alarm that can actuate an annunciator or perform an auxiliary control function when a process signal reaches a preset point, has been developed by Swartwout Company. The R2A unit can be installed with the alarm-point set from a remote location. It is a null-balance device that can be used for one or two-point alarm, operating independently of the instrument circuit or in parallel with any of the company's Autronic indicator-recorder-controller combinations.

The alarm is comprised of a plug-in case, containing the printed circuit cards, and a mounting frame. A safety interlocked mercury power-switch prevents disconnection, or circuit card removal, before power shutoff.

For more data, circle **No. E16** on Readers' Service Card, last page this issue.

Inverter Power Unit

Several improvements have been made on D. W. Onan & Sons, Inc., transistorized power unit developed for microwave communication emergencies. Instapac is now offered in 19-inch relay rack mounting with the necessary controls; or in a wall mount cabinet. Also it is available in three input voltages, 24V, 36V and 48V. Optional items such as battery charger, meters, (DC and AC voltmeters, and AC ammeter) and an output booster.

Instapac has been designed to work in conjunction with an emergency generating unit, to take over critical loads instantly and operate essential equipment until generating plant can take over.

For more data, circle **No. E17** on Readers' Service Card, last page this issue.

Truck Innovations

A diesel engine in pick-up trucks and a tractor equipped with air suspension and fiberglass-cab design are the new features of White Truck Division's line of trucks.

The 5400TD highway tractors introduce fiberglass cabs and air-spring system on the single rear drive axle. The 3016D city pickup and delivery diesel was developed for commercial, low-maintenance operation.

For more data, circle **No. E18** on Readers' Service Card, last page this issue.

Electrical Flow Switch

W. E. Anderson, Inc., anounces a new vane-operated, magnetically-actuated electrical flow switch. The unit, which is completely sealed from piped products, has been field tested by several transmission companies. The switch is applicable as protection of pumps against loss of line flow, automatic starting of auxiliary pumps, signaling flow or no-flow conditions and locations and providing fully automatic stop-start protection of pumping units at unattended booster stations.

The Flotect magnetic monitor is a vane-operated switch that mounts directly into the line and withstands 2,000 psi working pressure. It is available in a wide variety of kinds and types of materials—bronze, brass, steel and stainless steel to meet specific conditions.

For more data, circle **No. E19** on Readers' Service Card, last page this issue.

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Repair pipe leaks QUICKLY!

Speediest application — slotted lug permits the single plated bolt to slide instantly into place.

A companion to the old reliable Emergency Pipe Clamp that has served industry for a half century, the JUNIOR, a single bolt clamp, is 2⅞" wide. Undersells most band-type clamps.

Made of malleable iron, ruggedly proportioned, with full-length hinge along one side. Formed to exact pipe size—no bending. The recessed pressure-equalizing gasket, entire width of clamp, is cemented in. A lasting installation. 2" pipe size—$1.80; 2½"—$2.20; 3"—$2.30. Write for new circular on the Junior.

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EMERGENCY PIPE CLAMPS for safe, sure lasting repair of splits and rust holes in pipe. No pressure too high. Anyone can apply in a few moments. Made in all sizes, ½" to 12", for steel and C. I. pipe. Stocked by practically all oil supply stores.

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New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers' Index. Simply circle code numbers of items desired—sign and mail card.

Instrument Controls

General Controls Co. has issued an industrial controls catalog combining information from several catalogs. The catalog includes data on automatic temperature, pressure, level and flow controls as well as counters, switches and automation controls. Other items described and illustrated are industrial actuators, combustion instrument controls, controller indicators and pressure indicators.

Also there is a section on the company's "Hydramotors," electro-hydraulic actuators having many patterns, designs and valve body materials.

To get a copy, circle **No. E20** on Readers' Service Card, last page this issue.

Interchangeable Engines

International Harvester Company has released a catalog on its interchangeable diesel and carburated engines. The 12-page three-color booklet covers the UC-221 carburated and UD-236 diesel engines, rated at 75 maximum hp, and the UC-263 carburated and UD-282 diesel units, rated at 95 maximum hp.

Each pair of engines is interchangeable in power and dimensions. Engines are available with a variety of components and attachments to meet specific application requirements.

To get a copy, circle **No. E21** on Readers' Service Card, last page this issue.

Packaged Compressors

Cooper-Bessemer Corporation announces a new bulletin on its AM/2 and AM/4 packaged compressors for gas gathering. The eight-page booklet discusses the incorporation of large compressor concepts in the compact units. Construction details are presented on both the two-throw type and four-throw type, covering the complete range from 100 horsepower up.

The compressors are skidded, prepiped and provided with a closed water system by C-B Southern, Inc.

To get a copy, circle **No. E22** on Readers' Service Card, last page this issue.

Voltmeter

Southwestern Industrial Electronics Co. has issued a bulletin on its Model R-2 voltmeter. The bulletin specifies its applications such as measuring the regulation of power supplies, resolution of potentiometers, and linearity of amplifiers. Specifications and schematic diagram are included in the two-page bulletin.

To get a copy, circle **No. E23** on Readers' Service Card, last page this issue.

Speed Increaser

An eight-page illustrated bulletin describes space and weight-saving gears for speed reduction or speed increasing service on transmission applications. The De Laval Steam Turbine Company bulletin covers eight sizes of planetary and star gears used on compressor and blower drives, and as drives for turbines and internal combustion engines.

Drawings, construction details, capacity and selection curves, selection examples and tables of dimensions are included in the booklet.

To get a copy, circle **No. E24** on Readers' Service Card, last page this issue.

Microwave Service Channel

General Electric Communication Products Department has published a bulletin describing its transistorized service channel equipment available for 6KMC microwave.

The equipment is designed to simplify servicing of microwave systems and aids technicians in preventative maintenance.

To get a copy, circle **No. E25** on Readers' Service Card, last page this issue.

Butterfly Valve

The Henry Pratt Company has issued a bulletin which illustrates and explains the monoflange mark 11 rubber seal butterfly valve. This catalog includes complete specifications, certified dimension drawings, water flow data, gas flow data, weights and freight rates and prices. Bulletin 10 J2 includes schematic drawings of valves and sections on installation and operators.

To get a copy, circle **No. E26** on Readers' Service Card, last page this issue.

Crawler Tractor

General Motors Euclid Division has issued a 24-page brochure on the Model C-6 crawler tractor. The booklet is highly illustrated with photographs of job applications, cutaways, sectional views and drawings explaining full-power shift, torqmatic drive, hydraulic track tensioning and other design and operating features. Specifications and performance charts are included.

To get a copy, circle **No. E27** on Readers' Service Card, last page this issue.

Storage Tanks

A 14-page bulletin on storage system structures has been published by General American Transportation Corporation. Photographs and drawings are incorporated to illustrate the detailed booklet. The bulletin includes sections on the design, uses and construction of these conservation structures.

To get a copy, circle **No. E28** on Readers' Service Card, last page this issue.

Pipelayers

Caterpillar Tractor Company has published a four-page brochure describing features of the 572 Series D and MD7 pipelayers. Increased horsepower, dry-type air cleaner and lifetime-lubricated rollers are some of the features discussed.

Brief specifications and other design points such as console controls, and torque converter drive are listed.

To get a copy, circle **No. E29** on Readers' Service Card, last page this issue.

The Goodman Cylindrical Stopper

FOR GAS, OIL, WATER AND DRAIN PIPES

The Goodman Cylindrical Stopper is an inflatable bag with a rugged water-proofed casing which may be inflated to a high internal pressure and will hold against as much as ten pounds pressure in the pipe.

The broad central zone makes contact with the wall of the pipe and holds against a higher pressure than other types of bag.

This Stopper has been used successfully for testing soil pipes in new buildings and for stopping oil pipes around refineries. Water-works engineers use it to save pumping while altering or repairing mains where leaky valves are encountered. It is now giving satisfaction in sewer work, and in at least one instance it saved a city water-works a large expenditure of money.

Safety Gas Main Stopper Co., Inc.

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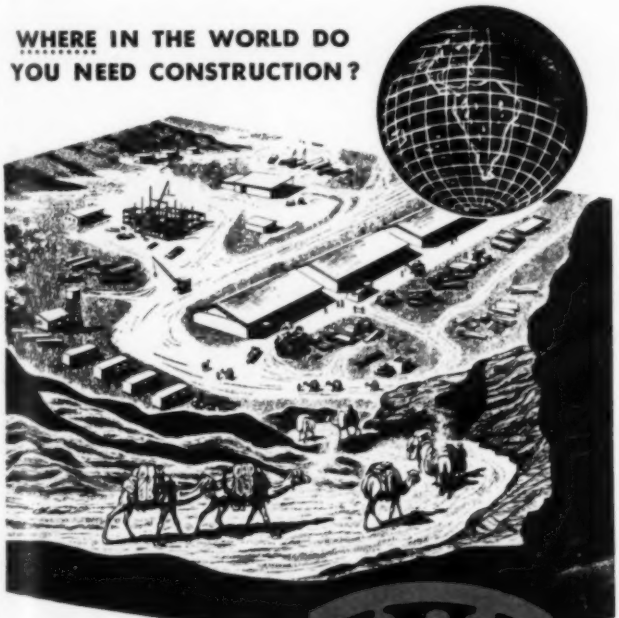

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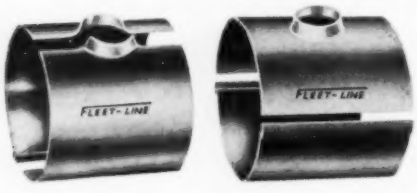

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• Dot preceding name of advertiser indicates that detailed data on products and services of the firm will be found in current (1959-60) second revision of The Pipe Line Catalog.

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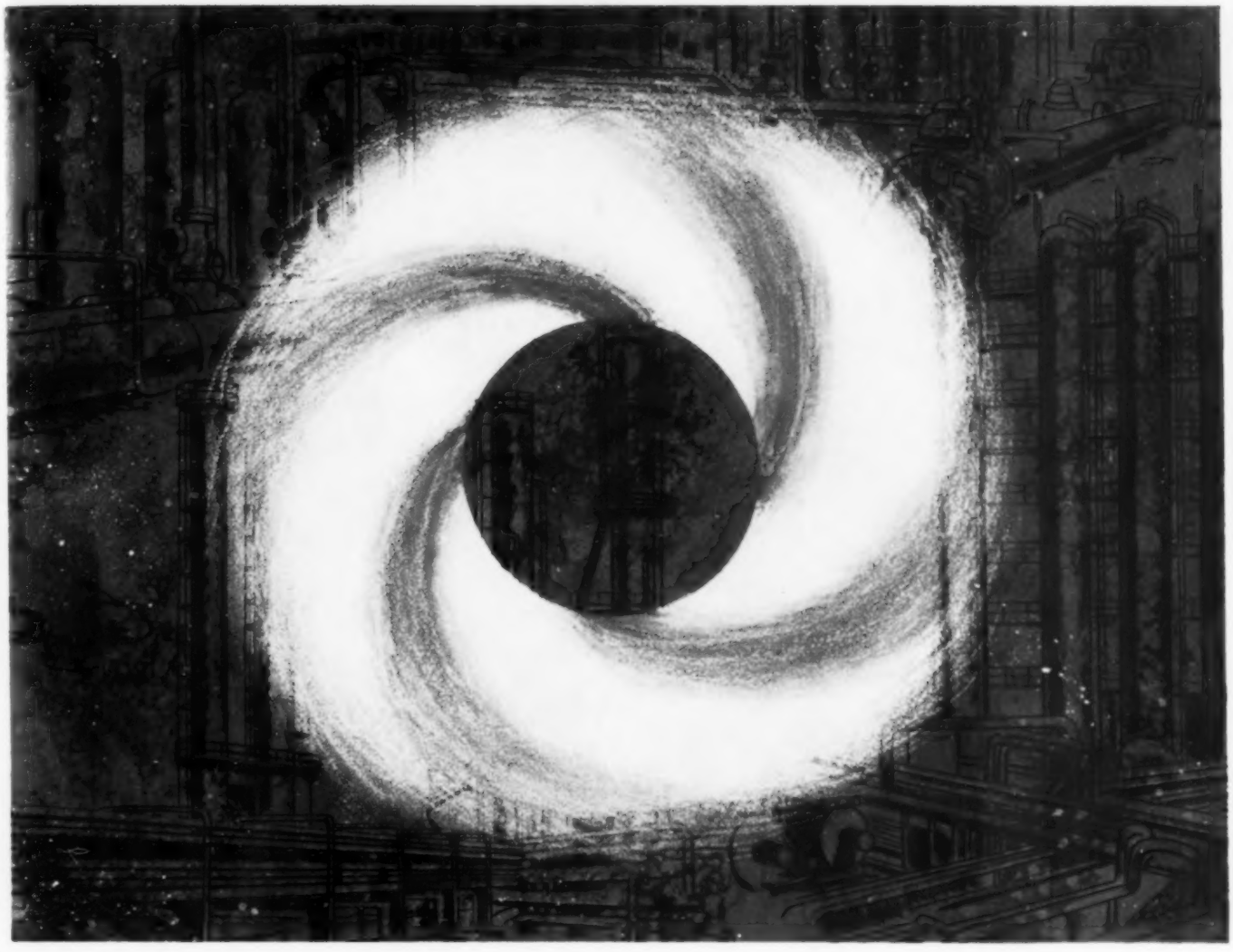

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ASA 150 lb. (275 cwp)
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Approved for many services including:

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The seats — made of specially formulated rubber molded to a hardened steel insert — are the secret to the valve's tight sealing performance. As line pressure in the valve increases, these unique seats actually float with the pressure to seal tightest where the most pressure is exerted.

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